Model 876CR Intelligent Electrochemical Transmitter for Contacting Conductivity and Resistivity Measurements with HART® Communications

Foxboro®

by **Schneider** Electric

Contents

Figures

Tables

1. Introduction

The 876CR Contacting Conductivity/Resistivity Transmitter converts conductivity or resistivity measurements to a 4 to 20 mA output signal with a superimposed HART digital signal for remote configuration and monitoring. A human machine interface is integral to the device and provides simplified menu-driven configuration, calibration, status, and diagnostic procedures.

A unique feature of this transmitter is that you can save up to two complete configuration programs and restore them at any time to facilitate a quick and easy change of the transmitter to a presaved configuration.

Reference Documents

The following documents provide additional and related information.

Document	Description
DP 611-260	Dimensional Print - 876PH, 876EC, and 876CR Transmitters
MI 611-206	Instruction - Intrinsically Safe Connector Diagrams and Nonincendive Circuits
MI 611-208 (a)	Instruction - Electrochemical Products Safety Information
PL 611-260	Parts List - 876PH, 876EC, and 876CR Transmitters

a. Available in many languages via our website. For help downloading this document contact our Global Customer Support Center.

Factory Default Passcode

The factory default passcode for both levels (Admin and User) is 0800.

2. Quick Start

The purpose of this section is to:

♦ Help you wire your transmitter

♦ Familiarize you with the instrument configuration as received from the factory

♦ Explain normal operation in Measure mode.

Wiring

⚠ WARNING

Wiring installation must comply with existing local regulations.

⚠ WARNING

For agency requirements, also see MI 611-206 (FM, CSA, IECEx) or MI 611-208 (ATEX).

Your 876CR Transmitter is a 2-wire transmitter. As such, it transmits output over the same two wires through which it receives power. Connect this power/output signal to the power terminals at the left of the printed wiring board inside the faceplate of your transmitter and the signal from your measurement sensor to the corresponding numbered terminals at the top of the terminal board. See Figure 1.

To access these terminals, unscrew the four captive screws from the corners of the bezel/keypad assembly and open the hinged assembly downward.

NOTICE

To minimize RFI/EMI effect, use grounded metal conduit on the sensor cable and input power leads.

NOTICE

The assembly does not open a full 180°. **Do not press on it while wiring**.

Figure 1. Wiring Connections for 876CR Transmitter
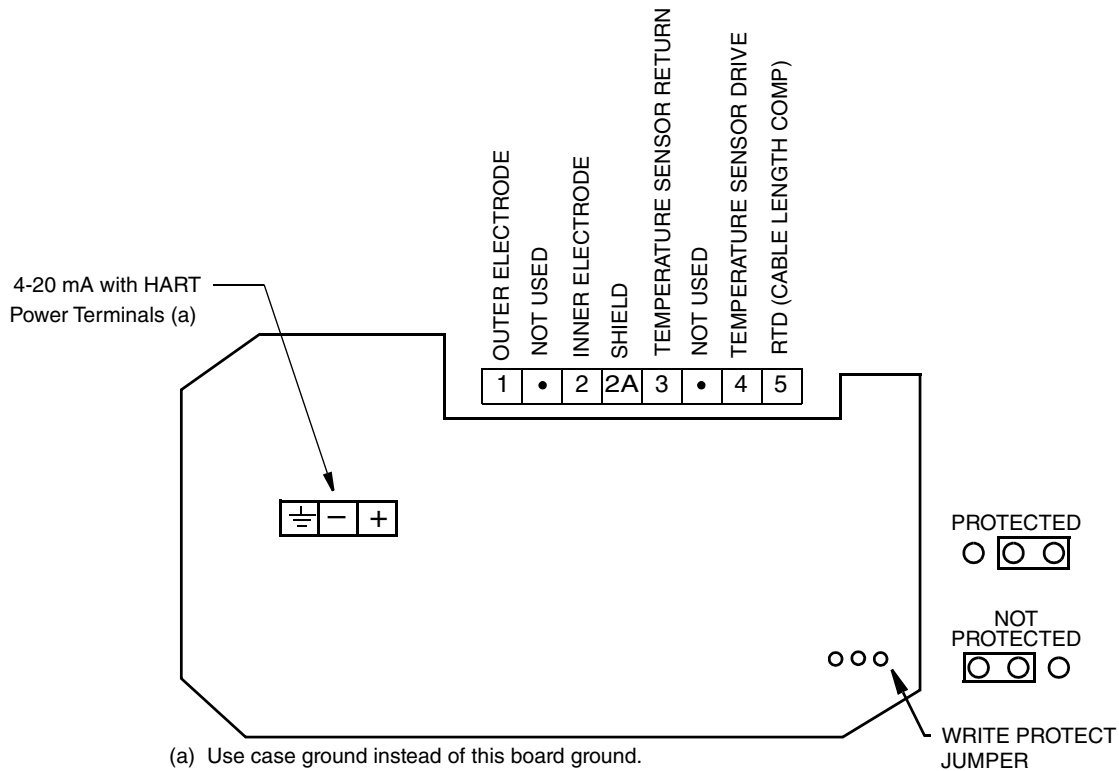
(a) Use case ground instead of this board ground.

NOTE:
There must be at least 250 ohms total resistance between the PC-based configurator or HART communicator and the power supply.

Checking Factory Configuration

In Configuration mode, following the structure diagrams in Appendix A and using the arrow keys, you can step through the product structure as configured in the factory. The factory default values are listed in Appendix B. The values in your transmitter may differ from these because your transmitter may have been configured at the factory to your specific requirements. In the table that comprises Appendix B, there is a column provided to make any notations you wish about your specific configuration.

To enter the Configuration mode, press the `Function` key and then the `Config` key. At the prompt, enter the passcode and press `ENTER`.

> **NOTE**
> The factory default passcode for both the Administrator and User is 0800.

Basic Operation in Measure Mode

Measure is the normal operating mode of your transmitter. One, two, or three measurements can be displayed depending on the configuration. When the display is configured for single line measurements, the value and unit are usually displayed. Any measurement can be viewed by scrolling with the Up and Down arrow keys. The display returns to the configured values when you press the Function key and then the Measure key or when the configured timeout period expires. When the transmitter is in Hold mode, a Hold indication appears in the upper right of the title bar. Whichever menu you are in, if there is a fault, a flashing fault symbol is displayed. If in Measure, Status, or Diagnostic mode, the word FAULT also flashes in the lower left of the display. When you press the Function key, the function indicator is displayed.

Figure 2. Sample 3-Line Measurement Display
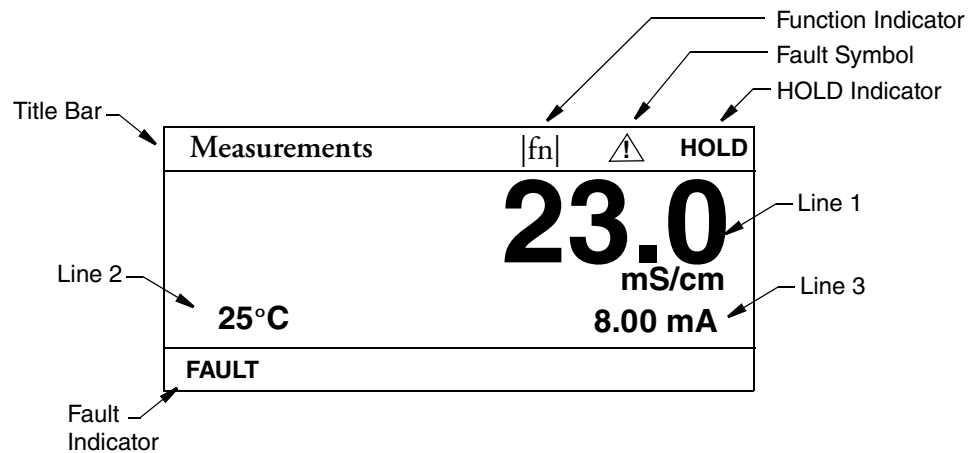
Looking for More Information?

For more detailed information, refer to the following sections of this manual:

♦ For detailed installation information, refer to "Installation" on page 19.

♦ For detailed explanation of the controls and indicators, refer to "Controls and Indicators" on page 25.

♦ For detailed configuration instructions, refer to "Configuration Mode" on page 40.

♦ For detailed calibration instructions, refer to "Configuration Mode" on page 40.

♦ For detailed operation from a HART Communicator, refer to "Operation Via HART Communicator" on page 61.

For dimensional information, refer to DP 611-260.

If you need additional help, contact our Global Customer Support Center at 1-866-746-6477.

3. Specifications

Functional and Physical Specifications

Sensors: 871CR and 871CC Series Conductivity/Resistivity Sensors. Contact Global Customer Support for limitations and procedures with other electrically compatible sensors.

Maximum Distance Between Sensor and Transmitter: 30 m (100 ft)

Temperature Compensation Inputs:

Factory precalibrated sensors from -30 to +200°C (-22 to +392°F)

100 Ω platinum RTD; 2 or 3 wires

1000 Ω platinum RTD; 2 or 3 wires

10 kΩ thermistor (thermistor is limited from -20 to 150°C)

100 kΩ thermistor (thermistor is limited from -20 to 150°C)

Solution Temperature: -30 to +200°C (-22 to +392°F)

Ambient Temperature:

Electronics: -30 to +70°C (-22 to +158°F)

Display: -20 to +70°C (-4 to +158°F)

> ─ **NOTE** ───────────────
> It is acceptable for the ambient temperature to go down to -30 °C. Though there will be a lag with displayed measurements, it will not damage electronics/display.

Relative Humidity: 5 to 95% noncondensing

Environmental and Corrosion Resistant Protection: The enclosure has the dusttight and weatherproof rating of IP66 as defined by IEC 60529, and provides the environmental and corrosion resistant protection rating of NEMA 4X.

Electromagnetic Compatibility (EMC): The transmitter, when installed in accordance with MI 611-260, meets EMC directive 2004/108/EC by conforming to the following EN and IEC Standards:

Radiated RF Immunity per IEC 61000-4-3

Radiated RF Emissions per EN 55011:199

Electrostatic Discharge per IEC 1000-4-2

Switching and Indirect Lightning Transient (Surge) per IEC 1000-4-5

High Frequency Transient per IEC 1000-4-4

Conducted RF Immunity per IEC 61000-4-6

Power Magnetic Field Effects per IEC 1000-4-8

Power Supply Requirements (for 4 to 20 mA output): 12.8 to 42 V dc (see Figure 8)

Load Limitations (for 4 to 20 mA output): 0 to 1300 ohms (see Figure 8)

Approximate Weight:

      Panel Mounted: 3.1 kg (6.8 lb)

      Surface or pipe Mounted: 3.7 kg (8.1 lb); includes mounting bracket

Product Safety Specifications

> **— NOTE**
>
> The 876CR Transmitters have been designed to meet electrical safety descriptions listed in Table 1. For detailed information, or status of testing laboratory approvals/certifications, contact Global Customer Support.

Table 1. Product Safety Specifications

Testing Laboratory, Types of Protection and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX II 1 G, Ex ia IIC Ga, intrinsically safe for Zone 0.	Temperature Class T4. Ta = -20 to 60°C.	AA
ATEX II 3 G, Ex ic IIC, intrinsically safe for Zone 2.	Temperature Class T4. Ta = -20 to 60°C.	AN
CSA Ex ia IIC; intrinsically safe for Zone 0; and **CSA** intrinsically safe, Class I, II, III, Division 1, Gas Groups A, B, C, D, E, F, G.	Temperature Class T4. Ta = -20 to 60°C.	CA
CSA Ex nL IIC; energy limited for Zone 2; and **CSA** for Class I, II, III, Division 2, Gas Groups A, B, C, D, E, F, G.	Temperature Class T4. Ta = -20 to 60°C.	CN
FM AEx ia IIC; intrinsically safe for Zone 0; **FMc** Ex ia IIC; intrinsically safe for Zone 0; and **FM** and **FMc** intrinsically safe, Class I, II, III, Division 1, Gas Groups A, B, C, D, E, F, G.	Temperature Class T4. Ta = -20 to 60°C.	FA
FM AEx nC IIC; energy limited for Zone 2; **FMc** Ex nL; energy limited for Zone 2; and **FM** and **FMc** nonincendive, Class I, II, III, Division 2, Gas Groups A, B, C, D, E, F, G.	Temperature Class T4. Ta = -20 to 60°C.	FN
IECEx Ex ia IIC Ga; intrinsically safe for Zone 0.	Temperature Class T4. Ta = -20 to 60°C.	DA
IECEx Ex nL IIC Gc; energy limited for Zone 2. and **IECEx** Ex ic IIC Gc; intrinsically safe for Zone 2.	Temperature Class T4. Ta = -20 to 60°C.	DN
NEPSI Ex ia IIC Ga; intrinsically safe for Zone 0.	Temperature Class T4. Ta = -20 to +60°C.	NA
NEPSI, Ex ic IIC Gc; intrinsically safe for Zone 2.	Temperature Class T4. Ta = -20 to +60°C.	NN
No Certifications	N/A	ZZ

4. Installation

Unpacking

1. Remove the transmitter from the shipping container and check for visible damage.
2. Save the container until you determine that no shipping damage has occurred.
   a. If no damage is observed, proceed to the mounting procedure.
   b. If transmitter has been damaged, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier and contact our Global Customer Support Center at 1-866-746-6477.

Identification

A data label is fastened to the left side surface of the enclosure. This label provides the model number and other information pertinent to your particular transmitter.

Figure 3. Sample Data Label

Mounting

Panel Mounting

Panel mounting of the transmitter is shown in Figure 4.

1. Cut the panel to receive the instrument.
2. Screw in the mounting screws at the back of the instrument.
3. Place the instrument into the panel and add bracket, washers and nuts from back side.

For panel cutout size, space requirements, and other dimensional data, see DP 611-260.

Figure 4. Panel Mounting
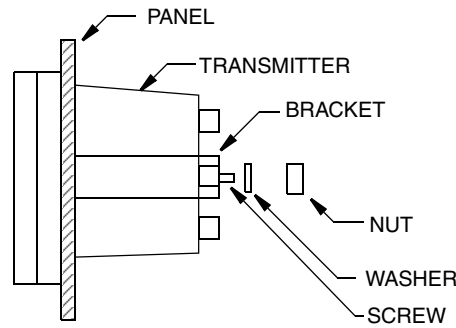
Surface Mounting

Surface mounting of the transmitter is shown in Figure 5.

1. Fasten the mounting bracket to the transmitter using screws, washers, and lockwashers provided.

2. Fasten the mounting plate to the surface using appropriate hardware.

For space requirements and other dimensional data, see DP 611-260.

Figure 5. Surface Mounting
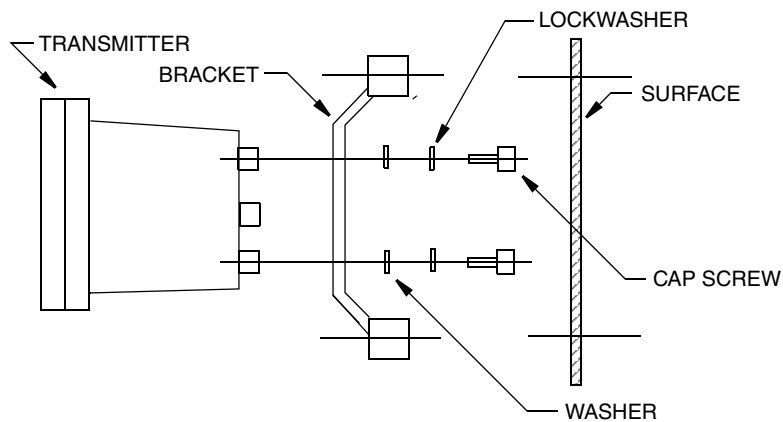
Pipe Mounting

Pipe mounting of the transmitter is shown in Figure 6.

1. Fasten the mounting bracket to the instrument using the hardware provided.

2. Securely fasten the mounting bracket to a DN50 or 2-in pipe with U-bolts supplied.

For space requirements and other dimensional data, see DP 611-260.

Figure 6. Pipe Mounting
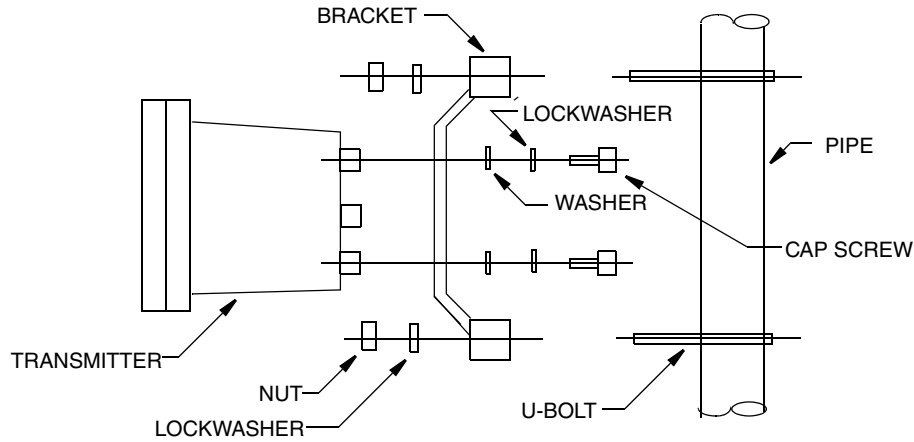
Wiring

⚠ WARNING

Wiring installation must comply with existing local regulations.

NOTICE

The bezel/keypad assembly does not open a full 180°. **Do not press on it while wiring**.

NOTICE

To minimize RFI/EMI effect, use grounded metal conduit on the sensor cable and input power leads.

Your 876CR Transmitter is a 2-wire transmitter. As such, it transmits output over the same two wires through which it receives power. Connect this power/output signal and the signal from your measurement sensor as follows:

1. Draw out the four screws on the corners of the faceplate and open the hinged door downward. install proper fittings in the left and right ports in the bottom of the case.

Table 2. Recommended Conduit and Fittings

Material	Conduit	Fitting
Rigid Metal	1/2 inch Electrical Trade Size	T&B (a) #370
Semi-Rigid Plastic	T&B #LTC 050	T&B #LT 50P or T&B #5362
Semi-Rigid Plastic Metal Core	Anaconda Type HV, 1/2 inch	T&B #LT 50P or T&B #5362
Flexible Plastic	T&B #EFC 050	T&B #LT 50P or T&B #5362

a. T&B = Thomas & Betts Corp., 1001 Frontier Road, Bridgewater, NJ 08807

2. Bring your power wires in the left opening in the bottom of the case and attach to the power terminals at the left of the printed wiring board. See Figure 7.

3. Bring the sensor wires in the right opening in the bottom of the case and attach to the appropriate terminals at the top of the printed wiring board. See Figure 7.

— NOTE

To maintain NEMA Type 4X and IEC IP66 protection, plug any unused openings with the plug, gasket, and locknut shown in PL 611-260.

4. Set the Write Protect jumper as shown in Figure 7.

Figure 7. Wiring Connections for 876CR Transmitter
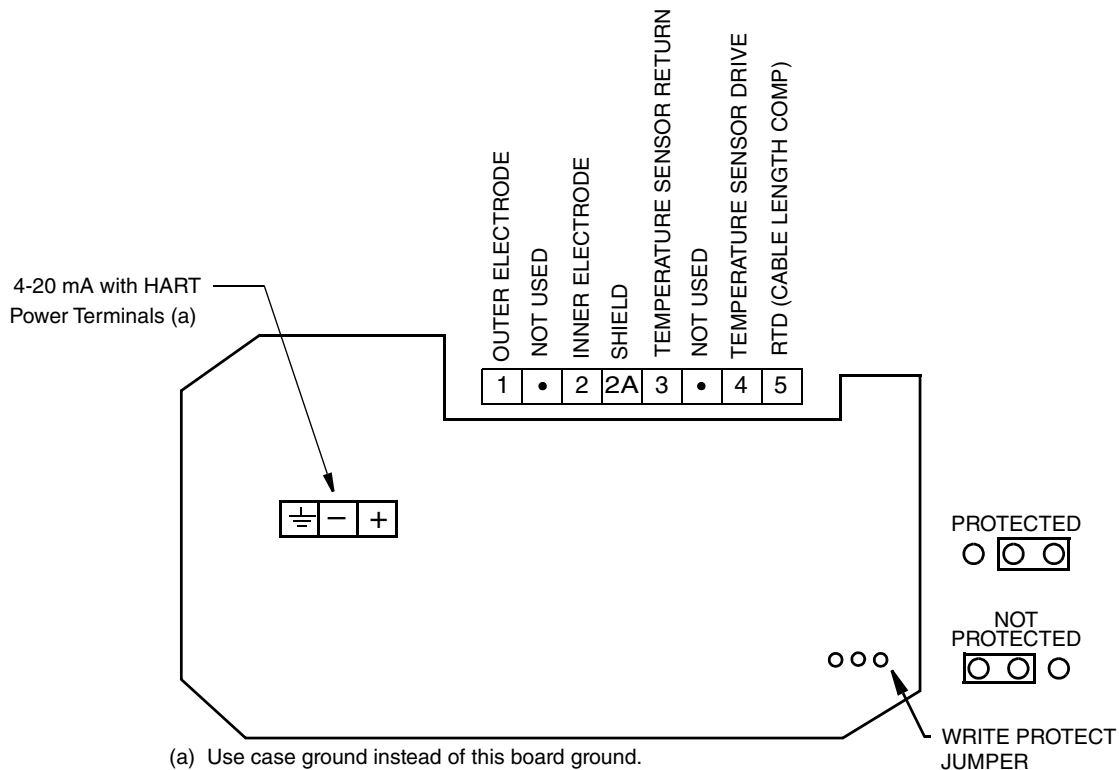
(a) Use case ground instead of this board ground.

NOTE:
There must be at least 250 ohms total resistance between the PC-based configurator or HART communicator and the power supply.

Voltage Load Requirements

The voltage load requirements are given in Figure 8.

Figure 8. Supply Power and Loop Load
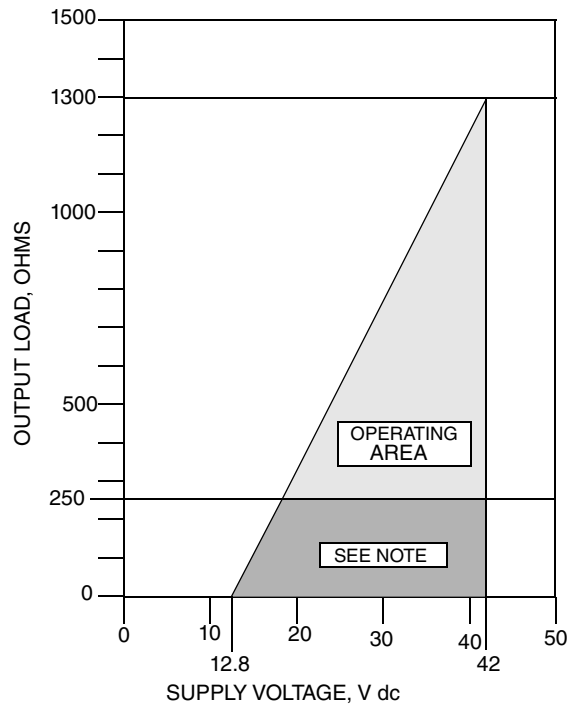
Examples:

1. For a loop load of 800 ohms, the supply voltage can be any value from 31 to 42 V dc.

2. For a supply voltage of 24 V dc, the loop load resistance can be any value from 0 to 517 ohms (250 to 517 ohms with a PC-Based configurator or a HART Communicator connected to the transmitter).

Sensor Cable Length

The length of the cable between the sensor and the transmitter can be 30 m (100 ft) maximum.

Write Protection Jumper

Your transmitter has write protection capability which fulfills the security requirements for safety systems. This means that the local display and remote electronics can be prevented from writing to the electronics. Write protection is set by moving a jumper that is located on the printed wiring board behind the front panel. To activate write protection, open the front panel and place it in the 'protect' position. See Figure 7. In the 'Not Protected' position, writing to certain functions can be limited by password protection.

5. Operation Via Local Display

Controls and Indicators

Operator controls and indicators are located on the front panel. Figure 9 shows the panel arrangement. Table 3 identifies the function of each element.

Figure 9. Front Panel Indicators and Controls
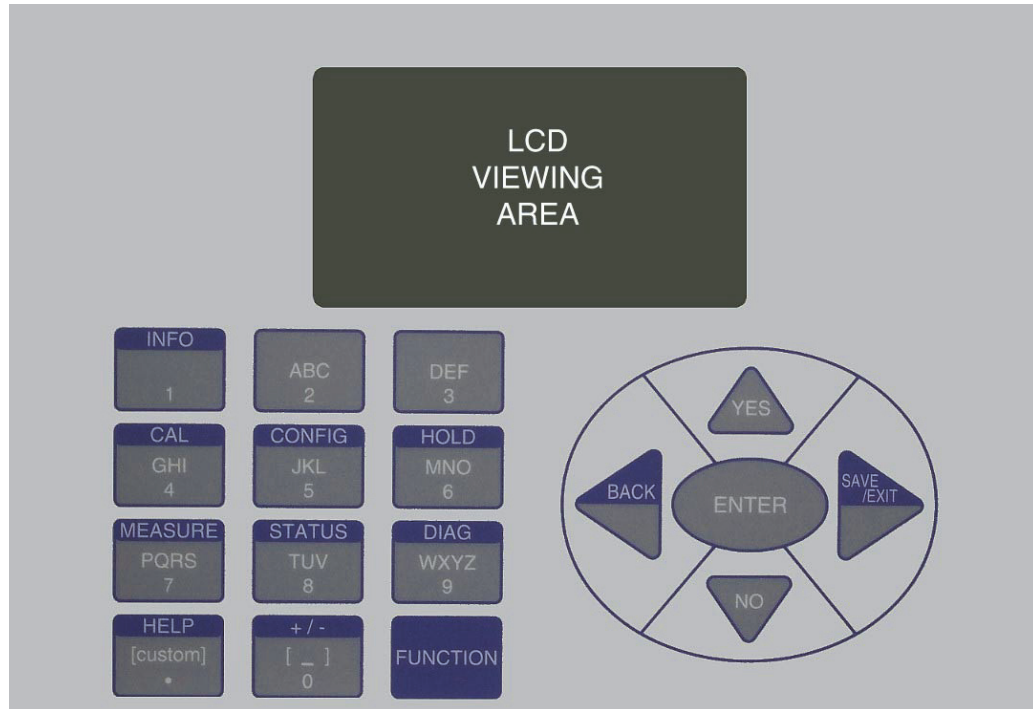
Controls

Table 3. Front Panel Indicators and Controls

Control/Indicator	Function
FUNCTION Key	Gives you access to the blue function keys.
INFO Key	Used with the Function key, describes the present parameter.
CALibration Key	Used with the Function key, places the transmitter in Calibration mode. This enables you to calibrate the transmitter to the values entered.
CONFIGuration Key	Used with the Function key, places the transmitter in Configuration mode. This enables you to configure the value of each parameter required for your application.
HOLD Key	Used with the Function key, places the transmitter in Hold mode. This enables you to hold the output at a determined value while configuring or calibrating the transmitter or performing sensor maintenance.
MEASUREment Key	Used with the Function key, places the transmitter in Measurement (normal operation) mode.
STATUS Key	Used with the Function key, places the transmitter in Status mode. This enables you to view the measurement and system parameters and thus assess the performance of the loop.
DIAGnostics Key	Used with the Function key, places the transmitter in Diagnostic mode. This enables you to further identify specific errors and possible solutions to an error flagged by the icon in Measurement mode. It is also a means to access the history log.
HELP Key	Used with the Function key, describes how to use the keypad to do the present operation and provides details of menu errors.
+/– Key	Used with the Function key, changes a + value to a – value and vice versa.
Alpha/Numeric Keys	Used for parameter entry. See explanation below.
Direction (Arrow) Keys	Moves you through the menu structure to subsequent menus and values. Also used to move the cursor and change character case.
ENTER Key	Enters (saves) the menu item or value selected. This is the only key that actually enacts a change.
BACK Key	Used with the Function key, moves you back one level in the menu structure regardless of menu errors.
SAVE/EXIT Key	Used with the Function key, asks you if you want to save your entries and then moves you to Measure mode.
YES Key	Used to answer Yes to a Yes/No question.
NO Key	Used to answer No to a Yes/No question.
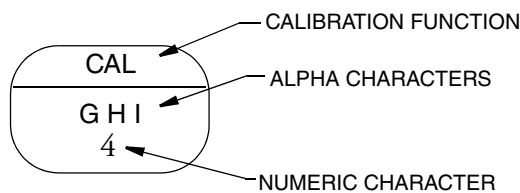
The alpha/numeric keys have several functions as follows:

♦ Access the function shown with a blue background

♦ Enter numeric values

♦ Enter alphabetic characters (for example, a HART tag, description, or message).

To enter an alpha character, use the key as you would on a cell phone. For example, to enter the word "Acid", use the following sequence"

1. Press the "2" key once to enter the "A" and use the Right arrow key to advance to the next character

2. Press the "2" key thrice to enter the letter "C" and press the Down arrow key to change it to lower case. Use the Right arrow key to advance to the next character.

3. Press the "4" key thrice to enter the letter "I" and press the Down arrow key to change it to lower case. Use the Right arrow key to advance to the next character.

4. Press the "3" key once to enter the letter "D" and press the Down arrow key to change it to lower case.

Indicators

The display can be configured to show one, two, or three measurements. However, any measurement can be temporarily scrolled onto the display by using the Up and Down arrow keys. The display returns to the configured values when you press the Function key and then the Measure key, or when the configured timeout period expires. When the transmitter is in Hold mode, a Hold indication appears in the upper right of the title bar. When you press the Function key, the function indicator is displayed. Whichever menu you are in, if there is a fault, a flashing fault symbol is displayed. If you are in Measure, Status, or Diagnostic mode, the word FAULT also flashes in the lower left of the display.

> — **NOTE** —————————————————————————————
>
> 1. If FAULT is displayed, details of the fault are shown in the Diagnostic mode.
>
> 2. If CHECK STATUS is displayed (in the Fault Indicator location), go to Status mode to check the status.

Figure 10. Sample 3-Line Measurement Display
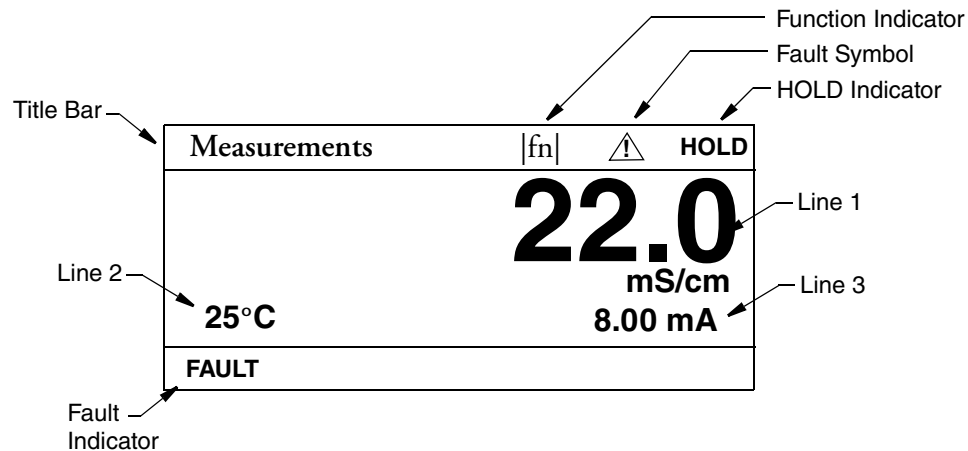
Password Access

Two levels of protection are available. Administrator (Admin Code) access permits changing all parameters in Configuration as well as specifying what parameters are accessible by those having User Code access. User (User Code) access permits changing and viewing access to those areas specified by the administrator. Both are 4-digit passcodes. The passcodes may or may not be the same. They are set as part of configuring the instrument.

Upon entering the Configuration, Calibration, or Hold mode, you will be prompted to enter a passcode. To exit, select another mode.

> **NOTE**
> Every passcode entry is added to the history log.

If entering Calibration or Configuration mode and you enter the correct passcode, the transmitter responds in one of three ways depending on how `Automatic Hold` is configured. If `Automatic Hold` is configured `Off`, the display cautions you that the transmitter is not in Hold mode. Press `ENTER` to continue. If `Automatic Hold` is configured `Present`, the display cautions that hold is engaged but that outputs are held at the present level. It then unlocks the mode. If `Automatic Hold` is configured `Manual`, the display briefly displays `Hold Engaged` and then unlocks the mode.

The initial factory default value for both Administrator and User passcodes is 0800.

To bypass the passcode, the administrator must configure a passcode of 0000.

Timeout

If there are no key presses within the configured timeout period, the transmitter reverts to Measure mode. You can also return to Measure mode by pressing the `FUNCTION` key and then the `MEASURE` key. If you are in Configuration or Calibration mode and the automatic hold feature was employed, the output becomes live when the transmitter times out. The timeout feature can be turned off in Configuration mode.

Viewing and Changing Data

In the Configuration, Calibration, Hold, and Diagnostic modes, you need to move through a structure of parameters (using the arrow keys and `ENTER` key) to view and/or change the value or status of a particular parameter. Structure diagrams, located in Appendix A, "Configuration Structure Diagrams" will aid you in doing this.

> **NOTE**
> 1. The Up and Down arrow keys scroll through a menu in either direction.
>
> 2. Using the `FUNCTION` key with the Up and Down arrow keys takes you to the top and bottom of a menu, respectively.
>
> 3. If a menu selection is invalid, you will see a selection in inverted text (white letters on black background). This choice is not selectable. It will disappear after you make your choice. To keep the selection, use the `BACK` key.

The following example will show you how to use the keys in moving through the structure. The example used is that of configuring temperature features. For the example, assume Fahrenheit temperature units, an automatic temperature mode, and a fail temp value of 77°F. Refer to Figure 11.

1. To enter the Configuration mode, press the `FUNCTION` key and then the `CONFIG` key. Press `ENTER`.

2. Press the Down arrow key three times to move from `Cell Configuration` to `Temp Config`. Press `ENTER`.

   The `Temp Config` screen is displayed. `Temp Units` is highlighted.

3. Press `ENTER`.

4. Use the Up or Down arrow key to move to °F and press `ENTER`. This enters your Fahrenheit selection and moves the display back to the `Temp Units` screen.

5. Use the Down arrow key to move to `Temp Mode`. Press `ENTER`.

   The `Temp Mode` screen is displayed.

6. Use the Up or Down arrow key to move to `Auto` and press `ENTER`. This enters your Auto Mode selection and moves the display back to the `Temp Mode` screen.

7. Use the Down arrow key to move to `Fail Temp`. Press `ENTER`.

   The `Fail Temp` screen is displayed.

8. Press the "7" key twice. Press `ENTER`. This enters your selection of 77 and moves the display back one level.

9. Press the `FUNCTION` and `SAVE/EXIT` keys to save your configuration.

Figure 11. Example of Structure Diagram
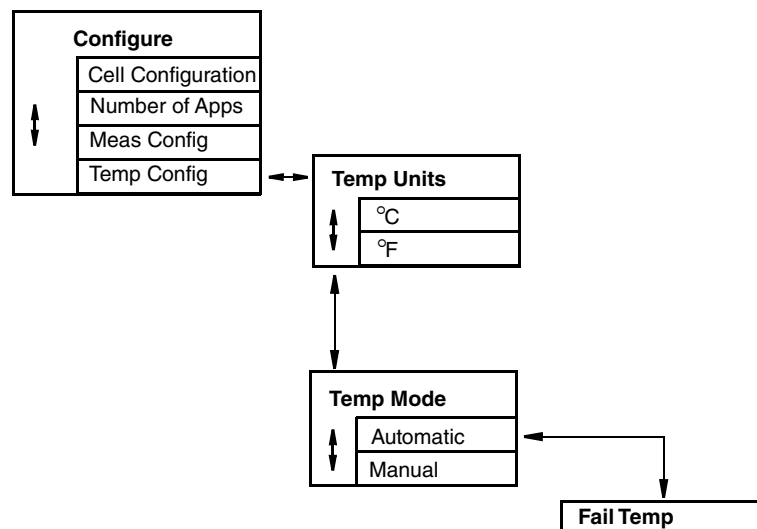
Measure Mode

Measure is the normal operating mode of your transmitter. Depending on your configuration, the display can show one, two, or three measured values. In the configuration mode, you can also configure what to display on each line. The choices are measurement, temperature, absolute value of the measurement, and the analog output (4 to 20 mA). The units are always shown with the measured values.

Any measurements may be viewed by scrolling with the up and down arrow keys. See Figure 12. The display returns to the configured values when you press the FUNCTION key and then the MEASURE key or when the timeout period expires. When the transmitter is in Hold, a hold indication appears in the upper right of the display. If there is a fault, a fault symbol is displayed in the title bar and, if in Measure, Status, or Diagnostic mode, the word FAULT flashes in the lower left of the display. See Figure 10.

Figure 12. Measure Mode Structure Diagram
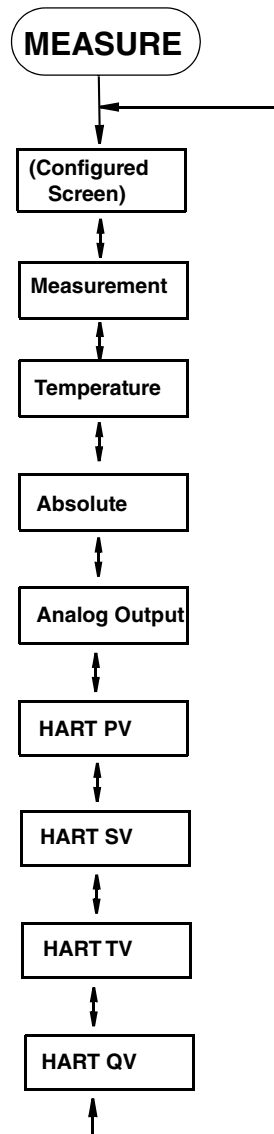
Status Mode

Refer to Figure 13.

The Status mode enables you to view the measurement and system parameters and thus assess the performance of the loop. You can not edit them in this mode. All measurements and outputs continue while you are in the Status mode.

To enter the Status mode, press the FUNCTION key and then the STATUS key. Move through the menu by using the Up and Down arrow keys. See Figure 13. The Status menu contains the following parameters:

Table 4. Status Parameters

Parameter	Description	Units	Notes
ATC Resistance	Temperature Sensor Resistance	Ohms or kOhms	
ATC Status	Temperature Sensor Status		
Temperature	Process temperature measurement	°C, °F	
Temp Status	Status of process temperature	- - -	See Table 5
Active Cell Factor	Cell Factor	Per centimeter (/cm)	
Cell Resistance	Cell Resistance	Ohms or kOhms	
Cell Status	Cell Status		
Absolute	Uncompensated measurement signal from sensor	MΩ•cm, KΩ•cm, mS/cm, mS/m μS/cm, μS/m, S/m	
Absolute Status	Status of absolute measurement	- - -	See Table 5
Measurement	Compensated measurement	MΩ•cm, KΩ•cm, mS/cm, mS/m μS/cm, μS/m, S/m	
Meas Status	Status of measurement	- - -	See Table 5
Concentration	Concentration	% or Custom	
Conc Status	Status of concentration	- - -	See Table 5
Calibrated By	Name of last operator	- - -	
Calibration Date	Date of last calibration (dd/mm/yyyy)	- - -	
Analog Output	Analog Output	mA	
Analog Output Status	Status of analog output	- - -	See Table 5
HART PV	PV measurement		
PV Status	Status of PV	- - -	See Table 5
HART SV	SV measurement		
SV Status	Status of SV	- - -	See Table 5
HART TV	TV measurement		
TV Status	Status of TV	- - -	See Table 5
HART QV	QV measurement		
QV Status	Status of QV	- - -	See Table 5
Model Code	Model code	- - -	
Sales Order	Sales order number	- - -	
Xmtr Serial Number	Transmitter serial number	- - -	
Firmware Revision	Firmware revision level	- - -	

Table 4. Status Parameters (Continued)

Parameter	Description	Units	Notes
Front End Revision	Front end revision level	- - -	For Global Customer Support use only
Boot Revision	Boot revision level	- - -	For Global Customer Support use only
Transmitter Type	Transmitter type (876CR)	- - -	
In Service	Time in service	Days	
HART Tag	HART Tag	- - -	
HART Long Tag	HART Long Tag	- - -	HART Versions 6 & 7
Tag Name	Tag name	- - -	
Location	Location of measurement	- - -	
Device Name	Device name	- - -	
HART Descriptor	HART Descriptor	- - -	
HART Message	HART Message	- - -	

Figure 13. Status Mode Structure Diagram

```
            ┌─────────────┐
            │   STATUS    │
            └─────────────┘
                  │
   ┌──────────────┼──────────────┬──────────────┬──────────────┐

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│ATC Resistance│ │Concentration│ │  HART TV    │ │Transmitter Type │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│ ATC Status  │ │Concentration│ │  TV Status  │ │   In Service    │
│             │ │   Status    │ │             │ │                 │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│ Temperature │ │Calibrated By│ │  HART QV    │ │   HART Tag      │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│ Temp Status │ │ Calibration │ │  QV Status  │ │ HART Long Tag   │
│             │ │    Date     │ │             │ │ (in HART 6 or 7)│
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│   Active    │ │Analog Output│ │ Model Code  │ │   Tag Name      │
│ Cell Factor │ │             │ │             │ │                 │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│Cell Resistance│ │   Analog   │ │ Sales Order │ │   Location      │
│             │ │Output Status│ │             │ │                 │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│ Cell Status │ │  HART PV    │ │ Xmtr Serial │ │  Device Name    │
│             │ │             │ │   Number    │ │                 │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│  Absolute   │ │  PV Status  │ │  Firmware   │ │     HART        │
│             │ │             │ │  Revision   │ │  Descriptor     │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐ ┌─────────────────┐
│Absolute Status│ │  HART SV   │ │  Front End  │ │  HART Message   │
│             │ │             │ │  Revision   │ │                 │
└─────────────┘ └─────────────┘ └─────────────┘ └─────────────────┘

┌─────────────┐ ┌─────────────┐ ┌─────────────┐
│ Measurement │ │  SV Status  │ │Boot Revision│
└─────────────┘ └─────────────┘ └─────────────┘

┌─────────────┐
│ Meas Status │
└─────────────┘
```

Table 5. Status Messages

Displayed Message	Meaning	Information on That Error (a)
Meas OK	Measurement OK	OK. All inputs and calculations for the measurement are OK.
1 InputFixed	Input is fixed	OK. Calculation based on an input is fixed at its manually set value.
Overridden	Measurement is overridden	Measurement has been put into hold mode.
Default	Measurement is fixed	OK. Measurement is fixed at the manually set value.
LimitSoftLow	The measurement is approaching the lower limit	Warning. The measurement is approaching the lower limit.
LimitSoftHi	The measurement is approaching the upper limit	Warning. The measurement is approaching the upper limit.
InputWarning	Input to measurement has a warning	Warning. Measurement input has a warning status.
LimitHardLow	Measurement below low limit	Bad. The measurement has dropped below hard lower limit.
LimitHardHi	Measurement above upper limit	Bad. The measurement has risen above hard upper limit.
1 Input Bad	Input to measurement is bad	Bad. An input to the measurement has a bad status.
MeasStarting	Inputs to measurement are not ready	Bad. A to D converter has not yet measured everything for this individual measurement.
InputStarting	Inputs to measurement are not ready	Bad. A to D converter has not yet measured everything for this individual measurement.

a. Displayed when the Function and Info keys are pressed for that fault.

Hold Mode

Refer to Figure 14.

> **— NOTE —**
> Hold mode may be protected. See "Password Access" on page 27.

The Hold mode enables you to manually hold the output at a determined value, thus allowing you to configure or calibrate the transmitter or perform sensor maintenance without disturbing the control system. Outputs are driven to a preconfigured state or held at their current values. During calibration, the transmitter continues performing live measurements.

> **⚠ WARNING**
> When entering hold, you have to take your loop out of auto control.

To enter the Hold mode, press the `FUNCTION` key and then the `HOLD` key. In the Hold mode menu, select `On Present` to hold all values and states at their current level or `On Manual` to set all values and states at desired levels or `Off` to release a hold.

If you select `On Present` and press the `ENTER` key, the display briefly reads `Hold Engaged` and proceeds to Measure mode and the outputs are held.

If you select `On Manual` and press the `ENTER` key, the display proceeds to `AO Hold`, the first of a series of parameters to set values and states to desired levels during hold.

> ┌─ **NOTE** ───
> Additionally, in Configuration mode, you can use the `Automatic Hold` parameter to
> automatically activate the Hold feature each time you enter Calibration or
> Configuration mode. In this Configuration mode parameter, you can select `Off`,
> `Present`, or `Manual`. However, if you select `Manual`, you must go to Hold mode to
> set the values.
> ──

To set the output for the analog output, enter a value from 3.6 to 22 mA.

You can fix the value for PV, SV, TV, and QV individually. When you have finished making the
manual selections, the display briefly reads `Hold Engaged` and returns to the Hold mode menu.

To release Hold, press the `FUNCTION` key and then the `HOLD` key. At the Enter Passcode prompt,
enter the correct passcode and press the `ENTER` key. If you enter the incorrect passcode, the display
repeats the prompt. If you enter the correct passcode, the display opens the Hold mode. Use the
Up or Down arrow key to select `Off` and press `ENTER`. The display briefly reads `Hold Released`
and returns to the Hold mode menu.

Figure 14. Hold Mode Structure Diagram
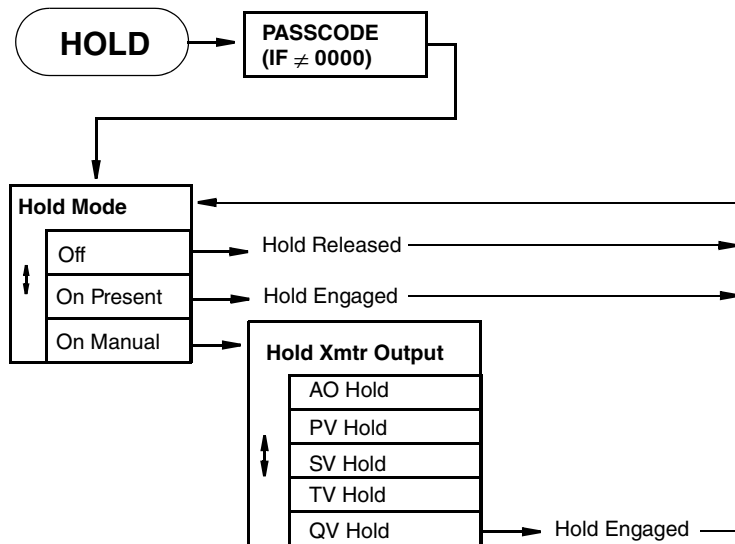
Calibration Mode

Refer to Figure 15.

> ┌─ **NOTE** ───
> 1. Calibration mode may be protected. See "Password Access" on page 27.
>
> 2. If using the `Automatic Hold` feature, the outputs are held at the present level or a
>   predetermined level. Returning to Measure mode releases the hold.
> ──

Four calibration selections are available: mA Cal, Measurement, Temperature, and Ultra Pure
Water. See Figure 15.

To enter the Calibration mode, press the `FUNCTION` key and then the `CAL` key. Press `ENTER`. The
display moves to the first parameter in Calibration mode. At the prompts, enter the name of the
person doing the calibration and the calibration day, month, and year.

mA Calibration

> **NOTE**
>
> It is not necessary to do a mA Cal (commonly known as mA Trim) unless there is a plant requirement to make the 4 and 20 mA output values exactly match the readings on certain plant calibration equipment, and the calibration operations that are done result in a small but unacceptable difference between the transmitter mA output and the test equipment mA readout values.

> **NOTE**
>
> mA Cal can be accomplished by inserting a digital current meter into the current loop and reading mA directly, or by connecting a digital millivolt meter across the mA Cal terminals on the printed wiring board (see Figure 1 or Figure 7) and dividing the millivolt reading by 25 ohms to get mA. The latter is recommended as it does not require interruption of the current loop.

> **NOTE**
>
> mA Calibration may not be an option when the HART Poll Address is not zero, and/or the mA Loop Mode is set to multi-drop. To change these settings, press the `FUNCTION` key and then the `CONFIG` key. Press `ENTER`. Scroll down to HART Digital and press `ENTER`.

To perform a mA calibration, select `mA Cal` and press `ENTER`.

1. Connect a digital current meter in the loop or a digital millivolt meter across the mA Cal terminals on the printed wiring board.

2. At the `Apply 4 mA to Loop` prompt, press `ENTER`.

3. At the `Known` prompt, enter the mA value measured with the current meter or the millivolt value measured with the millivolt meter divided by 25, and press `ENTER`.

4. At the `Apply 20 mA to Loop` prompt, press `ENTER`.

5. At the `Known` prompt, enter the mA value measured with the current meter or the millivolt value measured with the millivolt meter divided by 25, and press `ENTER`.

6. When calibration is done, the display reads `Calibration Complete`.

7. Press the `FUNCTION` key and `SAVE/EXIT` key to save your calibration.

Measurement Calibration

Process or Manual, 1- or 2-point calibrations with known solutions can be applied to conductivity, resistivity, or concentration.

Process or Manual

When you select the Process calibration option, the conductivity, resistivity, or concentration of the calibration solution at the reference temperature - not at the actual temperature - must be entered. When you select Manual calibration, the absolute conductivity or resistivity of the known solution at the actual temperature of calibration must be entered. In Manual calibration, even if units of concentration

have been chosen for display and output, the calibration values must be entered in the conductivity or resistivity units chosen under Base Units.

1- or 2-Point

Regardless of whether units of conductivity, resistivity, or concentration are selected for display and output, internal calibration calculations are carried out in conductivity units. A 1-point calibration calculates an adjustment only to the cell factor (same as slope or span), while the offset (intercept) is set to the true, electronic zero of conductivity. A 2-point calibration, on the other hand, applies adjustments to both the zero conductivity value (same as offset or intercept) and the cell factor.

Any type of measurement calibration completely supersedes previous measurement calibrations, including pure water CF and TCF previously entered. Changing Cell Type restores the factory default measurement calibration for the new nominal cell factor.

To perform a measurement calibration, select `Measurement` and press `ENTER`.

1. At the prompt, enter the number of calibration points (1 or 2).

2. At the next prompt, select the standard as `Manual` or `Process`.

   `Manual` presumes no knowledge being used by the transmitter of the calibration solution. You must enter the exact known value at the calibration temperature. No temperature compensation is applied in the firmware.

   `Process` presumes a grab sample of the process. You must enter a known value at the reference temperature (usually 25°C) from laboratory measurements. The configured application temperature compensation is applied.

   — **NOTE** ——————————————————————————————

   Process does not appear in the menu if you selected `Absolute` in `Temp Comp` (See "Temp Comp, A# Temp Comp" on page 45).
   ——

3. At the prompt, put the sensor in the first solution and press `ENTER`.

4. If you selected `Manual` in Step 2:

   The Absolute value is temporarily displayed while process is stabilizing.

5. At the prompt, enter the known measurement value at the current temperature and press `ENTER`.

6. If you selected `Process` in Step 2:

   Measurement/Temperature is temporarily displayed while process is stabilizing.

7. At the prompt, enter the known measurement value at the reference temperature (typically 25°C) and press `ENTER`.

8. Repeat Steps 3 and 4 or 3 and 5 as applicable.

9. When calibration is done, the display reads `Cal Complete`. Press `ENTER`.

10. Press the `Function` key and `Save/Exit` key to save your calibration.

Temperature Calibration

1- or 2-point user calibrations can be applied to the temperature measurement. A 1-point calibration applies an offset adjustment, that is, a fixed temperature adjustment across the entire range. A 2-point calibration applies a linearly varying adjustment across the span between the two chosen temperature points. Any type of temperature calibration completely supersedes previous temperature calibrations. Changing Cell Type restores the factory default temperature calibration.

To perform a Temperature calibration, select `Temperature` and press `ENTER`.

1. At the prompt, enter the number of calibration points as 1 or 2.

2. At the prompt, place the sensor in solution at the low temperature and press `ENTER`.

3. Temperature is temporarily displayed while process is stabilizing.

4. At the prompt, enter the known low temperature and press `ENTER`.

5. At the prompt, place the sensor in solution at the high temperature and press `ENTER`.

6. Temperature is temporarily displayed while process is stabilizing.

7. At the prompt, enter the known high temperature and press `ENTER`.

8. When calibration is done, the display reads `Cal Complete`.

9. Press the `Function` key and `Save and Exit` key to save your calibration.

Ultra Pure Water

In Ultra Pure Water calibration, 1-point adjustments (as described above) are applied to the resistivity and temperature measurements by providing inputs for a resistivity cell factor, CF (per cm), and temperature adjustment factor, TCF (°C), that were determined at the factory and can be found on the cell label. An Ultra Pure Water calibration completely supersedes all previous measurement and temperature calibrations. Changing Cell Type restores the factory default calibrations for the new nominal cell factor.

Figure 15. Calibration Menu Structure
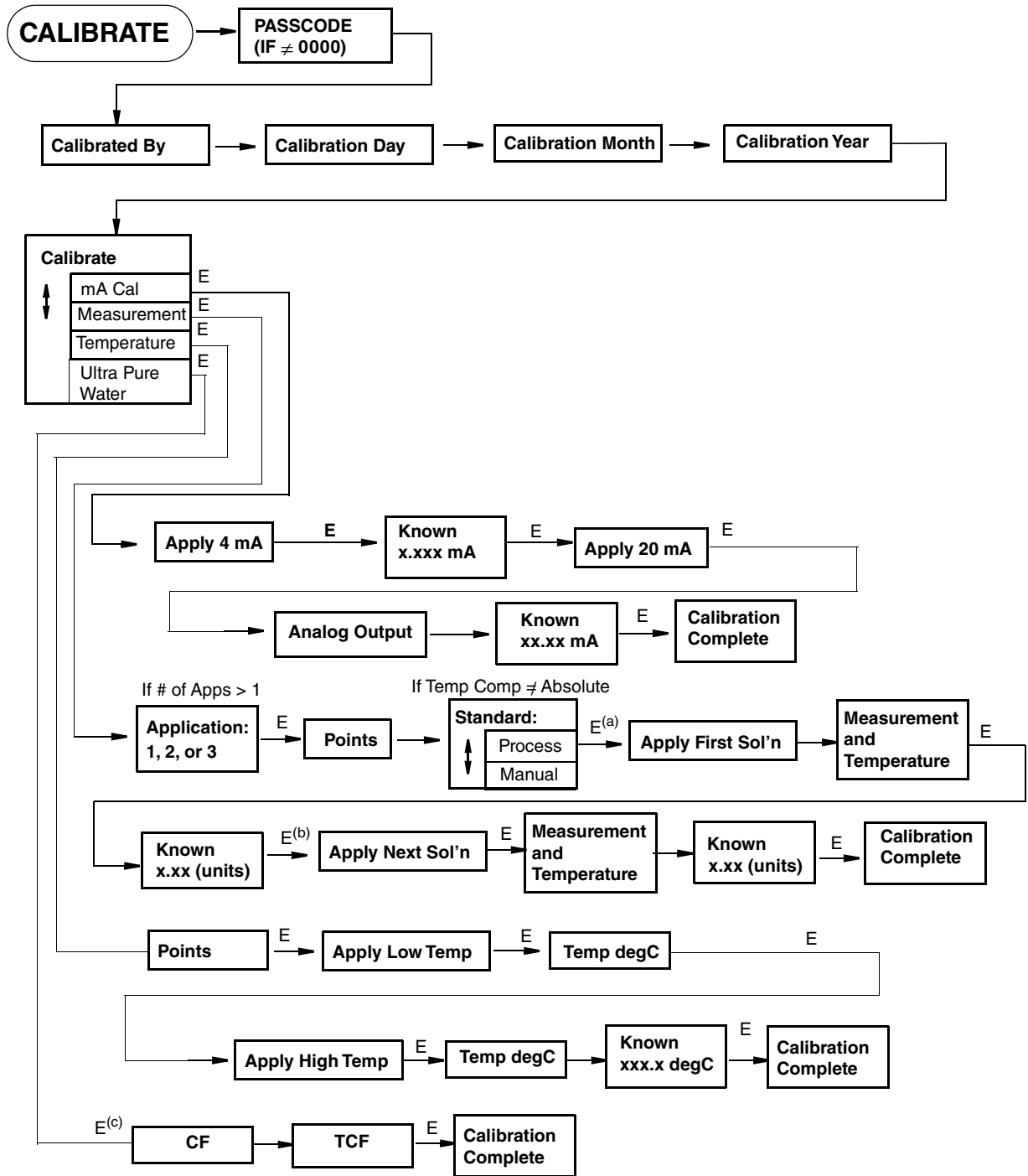
(a) If you configured more than application, enter the application number when prompted, and press Enter.

(b) If this is a 2-point calibration, you will be prompted to apply the next solution. Otherwise, Cal Complete appears on the display.

(c) If you configured more than one application, enter the application number when prompted, and press Enter.

Configuration Mode

NOTE
---

1. Configuration mode may be protected. See "Password Access" on page 27.

2. If using the `Automatic Hold` feature, the outputs are held at the present level or a predetermined level. Returning to Measure mode releases the hold.

Configuration is the process of establishing functional capability in the transmitter firmware for your application. This section helps you to systematically determine and configure the value or status of each parameter required for your application. It is recommended that you make configuration changes from the beginning of the menu structure forward. This is because menus are forward referencing meaning that if you start at the beginning and work to the end, you achieve a valid configuration. Also, the transmitter validates the configuration when attempting to exit configuration and directs you to any invalid parameters.

To enter the Configuration mode, press the `FUNCTION` key and then the `CONFIG` key. After gaining access to Configuration, the first category in the top level configuration structure, `Cell Config`, is displayed. To view or change another configuration category, press the Up or Down arrow key. When you have located the desired category, press the `ENTER` key. Each category of parameters is shown in subsequent structure diagrams.

⚠ CAUTION

If there are no key presses within the configured Timeout period, the transmitter reverts to Measure mode and all changes are lost.

Cell Configuration

Refer to Figure 28.

Cell Constant

This section of the structure asks you to specify the cell constant and the temperature features that are used for all three applications. Specify `Cell Const` as `0.1`, `1.0`, `10`, or `Other`.

If `Other`, specify the `Cell Factor` for the cell. The firmware allows a cell factor entry between 0.000 and 99.999. Contact Global Customer Support regarding the use of non-Foxboro cells with this transmitter.

Temperature Prediction[1]

Whenever a Foxboro cell type is selected, a proprietary mathematical algorithm is applied to accelerate the cell's response to changes in the process temperature. This reduces errors that may appear in the compensated measurements when the process temperature changes rapidly. If a Foxboro cell is not in use, for example while verifying transmitter response to resistor inputs, select cell type `Other`.

---

1. Patent pending.

Temperature Type

Specify the temperature type as **2-Wire Pt 100**, **2-Wire Pt 1000**, **10 kΩ Thermistor**, **100 kΩ Thermistor**, **3-Wire Pt 100**, or **3-Wire Pt 1000**.

Figure 16. Sensor Types
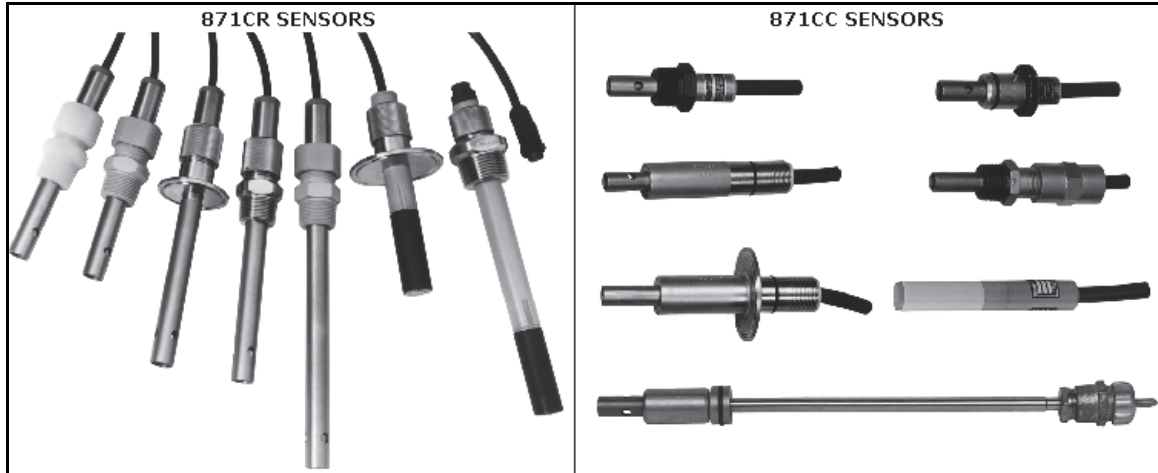
Table 6. 871CC and 871CR Sensor Types

Sensor Type	Model	Temperature Sensor
871CC	-A	Thermistor, 100 kΩ
	-B	
	-C	
	-D	
	-E	
	-F	
	-G	
	-K	100 Ω platinum RTD, 2-wire
	-L	
	-M	
871CR	-A	Class B 1000 Ω RTD, 3-wire
	-B	Class A 1000 Ω RTD, 3-wire
	-C	Class B 1000 Ω RTD, 3-wire

Number of Apps

Refer to Figure 29.

This section of the structure asks you to specify the number of applications you wish to preconfigure. It can be **1**, **2**, or **3**. For more information on this subject, see the following section and "Run Apps" on page 51. In the following subsections, "A#" indicates the application number 1, 2, or 3.

A# Configuration

The 876CR Analyzer can be preconfigured for up to three distinct applications. Each application can have its own measurement and temperature configuration, temperature compensation curve, display, and output configuration. Each user configuration may contain up to three applications. Applications can also autoswitch.

A# Name

Enter the name of the application up to a maximum of 12 characters.

Meas Config, A# Meas Config

Refer to Figure 30.

Meas Unit

Specify the measurement units as follows:

For Cell Constant of 10 or 1.0: kΩ•cm, µS/cm, µS/m, mS/cm, mS/m, S/m,%, or `Custom`.

For Cell Constant of 0.1: MΩ•cm, kΩ•cm, µS/cm, µS/m, mS/cm, mS/m, S/m, or `Custom`.

For Cell Constant of Other, contact Global Customer Support.

Display Format

Measurement Unit: **MΩ•cm, kΩ•cm, µS/cm, µS/m, mS/cm, mS/m, S/m**

If you selected one of these measurement units, you must specify the Display Format (decimal point placement) of the displayed value per Table 7, and Damping.

Table 7. Display Format

Cell Factor	Unit	Display Format - 0.9999 to 9999 (a)				
0.1		0.9999	9.999	99.99	999.9	9999
1.0	µS/cm	0.9999	9.999	99.99	999.9	9999
10		0.9999	9.999	99.99	999.9	9999
0.1		0.9999	9.999	99.99	999.9	
1.0	µS/m		9.999	99.99	999.9	9999
10				99.99	999.9	9999
0.1		0.9999	9.999	99.99	999.9	
1.0	mS/m	0.9999	9.999	99.99	999.9	9999
10		0.9999	9.999	99.99	999.9	9999
0.1		0.9999	9.999			
1.0	mS/cm	0.9999	9.999	99.99		
10		0.9999	9.999	99.99	999.9	
0.1		0.9999				
1.0	S/m	0.9999	9.999			
10		0.9999	9.999	99.99		

a. In this table, "9" represents a placeholder for a digit. The actual measurement capability is determined by the cell factor and units selected.

Damping

Enter the `Damping` response time up to 300 seconds (for 90% recovery from a step change). To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

Meas Unit = %

If you selected % as your measurement unit, you must specify the Chemical and Concentration at a reference temperature of 25°C (77°F). The instrument automatically applies the appropriate temperature compensation. The Chemical and Concentration selections are shown in Table 8.

Table 8. Chemicals and Maximum Concentration

Chemical	Reference Temperature	Concentration Range	Temperature Compensated Range	Base Display Scale
Sodium Chloride (NaCl)	25°C	0 to 28%	0 to 252 mS/cm	999.9 mS/cm
Potassium Chloride (KCl)	20°C	0.5 to 16%	8 to 220 mS/cm	999.9 mS/cm
Acetic Acid (CH_3COOH)	25°C	0 to 15%	0 to 1.8230 mS/cm	9.999 mS/cm
Phosphoric Acid (H_3PO_4)	25°C	0 to 36%	0 to 210 mS/cm	999.9 mS/cm

Then specify the base units so that the measurement can be displayed in those units. The `Base Unit` selections are MΩ*cm, kΩ*cm, µS/cm, µS/m, mS/cm, mS/m, S/m.

Lastly, enter the `Damping` response time (for 90% recovery from a step change). You can enter a time up to 300 seconds. To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

Meas Unit = Custom

If you selected **Custom** as your measurement unit, you must specify the `Custom Units` and `Custom Scale`. The `Custom Unit` selections are `%` (percent), `g/l`, (grams per liter), `ppm` (parts per million), `oz/gal` (ounces per gallon), `ppt` (parts per thousand), `User defined`, and `(none)`. The `Custom Scale` selections are `99.99`, `999.99`, `999.9`, `9999.9`, `9999`, `99999`, `0.99999`, `0.9999`, `9.9999`, `9.999`, and `99.999`.

Further, you must specify the chemical compensation, the relationship between the conductivity/resistivity units (`Base Units`) and the `Custom Unit` of your choice. The Base unit selections are MΩ*cm, kΩ*cm, µS/cm, µS/m, mS/cm, mS/m, S/m. The `Base Scale` selections are `0.9999`, `9.9999`, `9.999`, `99.99`, `999.9`, and `9999`.

The process specific compensation data must be generated or extracted in advance of entering it into the analyzer. We suggest that the data be plotted graphically as well as tabularly to prepare it for entry into your analyzer. See Figure 17.

Next, you must specify a number of points (`Num of Pts`) to plot the compensation curve. The number of points can be specified from 2 to 21. Lastly, for each of the number of points specified above, specify a base value (`Base Point #`) and the corresponding custom value (`Custom Point #`).

A maximum or minimum difference between successive concentrations is not required. The intervals do not have to be evenly spaced. We suggest 2 or 3 points be used in linear regions and more data points be used in curved regions. See Figure 18.

Figure 17. Reference Conductivity vs. Concentration Data
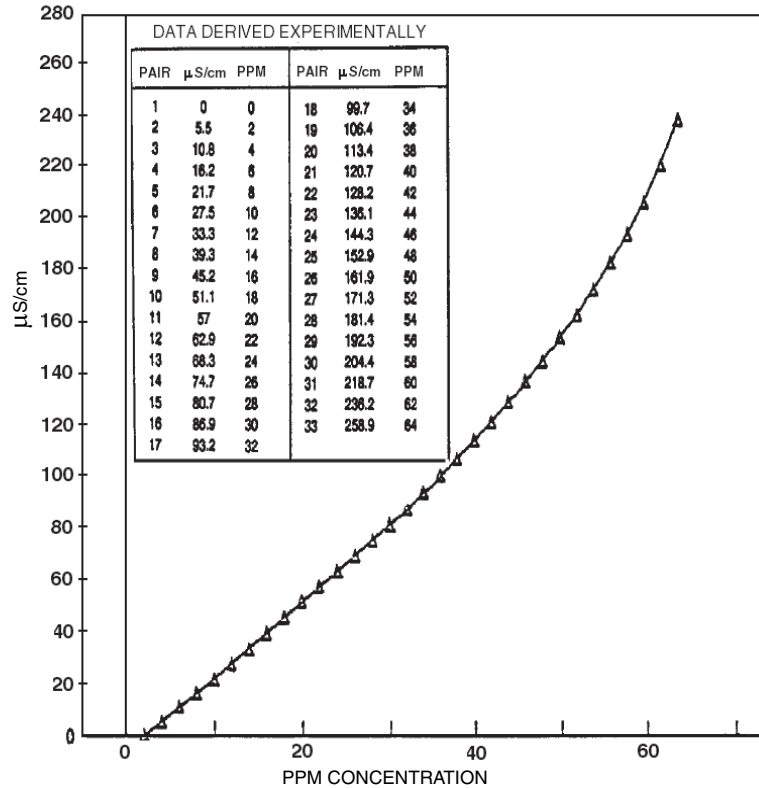
Figure 18. Configured Conductivity vs. Concentration Data
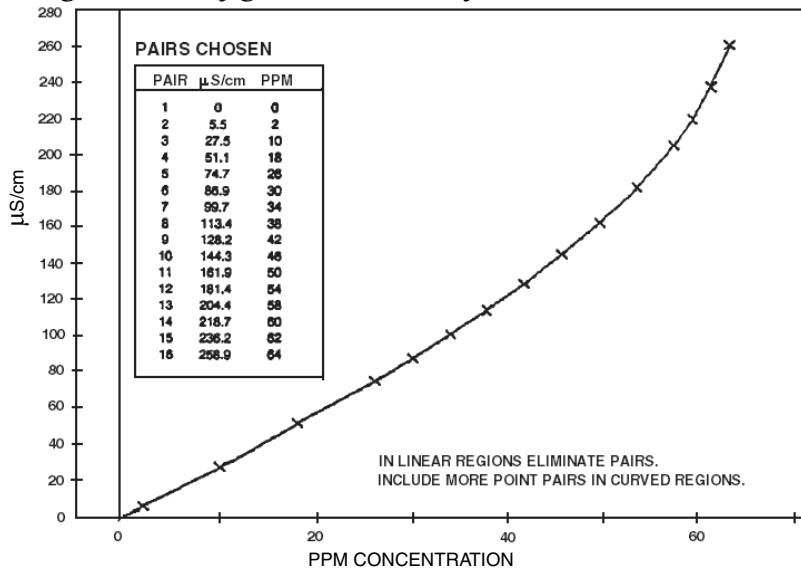
In the example used in Figure 17 and Figure 18, the 33 reference points were reduced to 16 configured points. The configuration procedure would have been as follows:

1. Specify your `Meas Units` as `Custom` and `Custom Units` as `ppm`.

2. Specify the scale of your custom units. For this example, because they are from 0 to 64 ppm and the degree of accuracy is only required in whole units of percent, specify `Custom Scale` as `9999.`

3. Specify the `Base Units`. For this example, µS/cm.

4. Specify the scale of your base values. For this example, because they are from 0 to 258.9, specify `Base Scale` as `999.9`.

5. Specify the number of points (`Num of Pts`) on your curve. For this example, `16`.

6. Specify the sixteen point pairs.

> ─ **NOTE** ────────────────────────────────────
> When entering data, remember to check the ± sign at the left of your display.

Lastly, enter the `Damping` response time (for 90% recovery from a step change). You can enter a time up to 300 seconds. To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

Temp Config, A# Temp Config

Refer to Figure 31.

Temp Unit

Specify `Temp Unit` as °C or °F. All references to temperature appear in the specified units within the transmitter software.

Temp Mode

Specify the `Temp Mode` as `Automatic` or `Manual`.

In `Automatic` mode, the temperature follows the temperature input RTD and you can set a temperature fail signal value (`Fail Temp`), in case the RTD fails, at the temperature at which you expect the process to be operating.

In `Manual` mode, the temperature can be set at a fixed temperature value (`Manual Temp`) and resistance inputs on the temperature terminal are ignored.

Temp Comp, A# Temp Comp

Refer to Figure 32.

Conductivity and resistivity measurements change as a result of ionic contaminants and temperature (heat causes ions to have more mobility in solutions, hence increasing the solution conductivity). Temperature compensation permits measurements to be made with minimal influence from temperature. Temperature compensation adjusts the measurement to a reading equivalent to that at the reference temperature (typically 25°C). For example, the resistivity of Ultra Pure Water at 25°C is 18.18 MΩ•cm. The resistivity of Ultra Pure Water at 30°C is 14.08 MΩ•cm. By compensating the resistivity reading, the value of Ultra Pure Water always reads 18.18 MΩ•cm.

This section of the structure asks you to specify the temperature compensation for your application.

Meas Unit Configured kΩ•cm, mS/cm, mS/m, μS/cm, or μS/m

If `Meas Units` was configured as **kΩ•cm, mS/cm, mS/m,** μS/cm, or μ**S/m**, or Custom you are first asked to specify the mode as `Absolute (none)`, `NaCl`, `KCl`, `Cation`, `Linear`, `H3PO4`, `CH3COOH`, `USP23/24`, `Ammonia`, `Morpholine`, `Ions Only`, or `Custom`.

`Ions Only` excludes the conductivity of water, representing the conductivity contribution of the solute only. In all other cases, except `Absolute` and `Custom`, the conductivity contribution of water is handled separately from that of the solute and the compensated value represents the total conductivity of both components. This is significant only in very dilute solutions. When `Custom` is chosen, water is ignored and the compensation from the custom table is applied to the entire conductivity. When `Absolute` is chosen, no compensation occurs.

Additional information about each is given in Table 9.

Table 9. Temperature Compensations

Tempcomp Menu	Additional Information	Temperature Range
Absolute	No Temp Comp applied	Instrument Range
NaCl	Sodium Chloride	0 to 200°C (32 to 392°F)
KCl	Potassium Chloride (20°C Ref)	0 to 50°C (32 to 122°F)
Cation	Only applicable for 1, 2, 5, or 10 μS/cm	-10 to 122°C (14 to 252°F)
Linear	- - -	Instrument Range
H_3PO_4	Phosphoric Acid (25°C Ref) (0-3%)	4.4 to 93.3°C (40 to 200°F)
CH_3COOH	Acetic Acid (25°C Ref) (0-8%)	0 to 110°C (32 to 230°F)
Ammonia	NH_3 (25°C Ref)	0 to 100°C (32 to 212°F)
Morpholine	Morpholine (25°C Ref)	0 to 100°C (32 to 212°F)
Ions Only	Sodium Chloride (25°C Ref)	0 to 100°C (32 to 212°F)
Custom	(25°C Ref)	As Entered

`Absolute` means that there is no temperature compensation applied.

`NaCl` is based upon Ultra Pure Water with the neutral salt, sodium chloride, considered as the primary ionic contaminant. This compensation can be used with measurements above 50 μS/cm and with solution temperatures between 0 and 200°C (32 and 392°F).

`KCl` is based upon water with the neutral salt, potassium chloride, considered as the main contributor to conductivity. It can be used with measurements between 0 and 16% KCl in conductivity samples with temperatures from 0 to 25°C (32 to 77°F). The reference temperature is 20°C (68°F).

`Cation` This compensation is used for process waters with trace acid as is found in boiler feed and steam samples from steam power plants (called cation conductivity or acid conductance). With this compensation, your analyzer corrects the conductivity to that of the solution at 25°C (77°F) using a compensation algorithm based on dilute HCl. This compensation can be used with solution temperatures between 0 and 100°C (32 and 212°F) and with solution conductivities between 0 and 10 μS/cm.

`Linear` This compensation is based on Ultra Pure Water and can be used when other compensation choices are not appropriate for your application. By entering a linear slope value that is representative of your solution's conductivity change with temperature, your analyzer multiplies the factor entered by the temperature deviation times the absolute conductivity. Therefore, if you selected `Linear`, enter the reference temperature (`Ref Temp`) and specify the slope of the linear compensation curve (`Lin Slope`) between 0.5 and 5.0 %/°C.

`H3PO4` This compensation is based upon Ultra Pure Water with trace Phosphoric acid considered as the primary acidic contaminant. Phosphoric acid is sometimes used in CIP operations. This compensation is used with measurements above 10 μS/cm and with solution temperatures between 5 and 90°C (40 and 200°F).

`CH3COOH` This compensation is based upon Ultra Pure Water with dilute acetic acid used as the primary acidic contaminant. Acetic acid is sometimes used in CIP (clean in place) operations. This compensation is optimized for measurements above 10 μS/cm and can be used with solution temperatures between 5 and 120°C (40 and 250°F).

`Ammonia` This power industry compensation is based upon Ultra Pure Water with trace NH_3 as found in cycle chemistry sample in power plants. This compensation can be used with solution temperatures between 0 and 100°C (32 and 212°F).

`Morpholine` This power industry compensation is based upon Ultra Pure Water with trace Morpholine as found in cycle chemistry sample in power plants. This compensation can be used with solution temperatures between 0 and 100°C (32 and 212°F).

`Ions only` causes the instrument to follow temperature compensation for a sodium chloride salt and causes the conductivity reading to remove the conductivity due to water. An Ultra Pure Water sample reads 0.00 μS/cm at 25°C (instead of 0.055 μS/cm).

`Ultra Pure H2O` assumes the only contaminant in ultra pure water to be NaCl, separates the conductivity at the temperature of measurement into contributions from ultra pure water and NaCl, converts these contributions to their equivalents at 25°C, combines them, and outputs the equivalent resistivity at 25°C. The temperature curve for ultra pure water is that of Light et al. (Electrochemical and Solid-State Letters, 8 (1) E16-E19 (2005)).

`Custom` If you selected this compensation, the prompts ask you to specify a reference temperature (`Ref Temp`) and a number of points (`Num of Pts`) to plot a compensation curve. The process specific compensation data must be generated or extracted in advance of entering it into the analyzer. We suggest that the data be plotted graphically as well as tabularly to prepare it for entry into your analyzer. See Figure 19.

In entering the data, `Num of Pts` can be specified from 2 to 21 points. Each point specifies a conductivity value at a certain temperature. The `Temp/Pnt n` can be specified between -30 and +200°C or -22 to +392°F by in 0.1° increments. The temperature units (Celsius or Fahrenheit) are specified under "Temp Unit" on page 45. The `Value/Pnt n` can be specified from 0 to five times the scale value chosen.

─ **NOTE** ────────────────────────────────────
When entering data, remember to check the ± sign at the left of your display.
──

The data should be input to the analyzer with increasing values of temperature.

─ **NOTE** ──────────────────────────────────

1. The temperature values must be entered in increasing or decreasing order or the display will read `Slope Error`.

2. Actual database saving of the compensation table is not performed until the last point pair is entered.

──

A maximum or minimum temperature difference between successive temperatures is not required. The intervals do not have to be evenly spaced. We suggest 2 or 3 points be used in linear regions and more data points be used in curved regions. See Figure 19 and Figure 20.

Figure 19. Reference Conductivity vs. Temperature Data
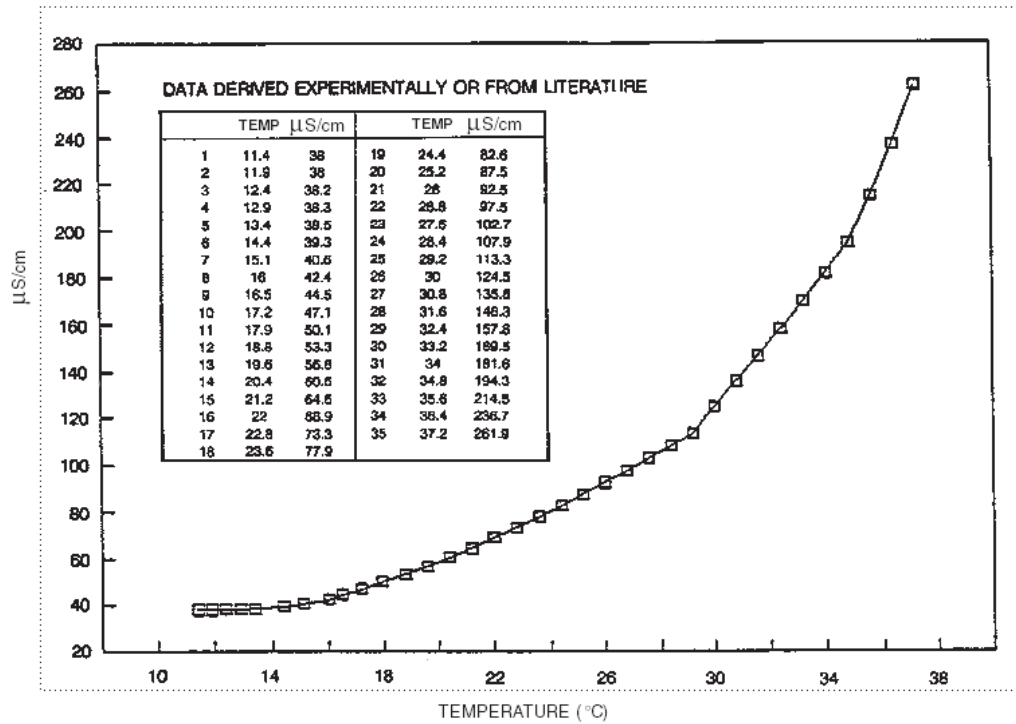
Figure 20. Configured Conductivity vs. Temperature Data
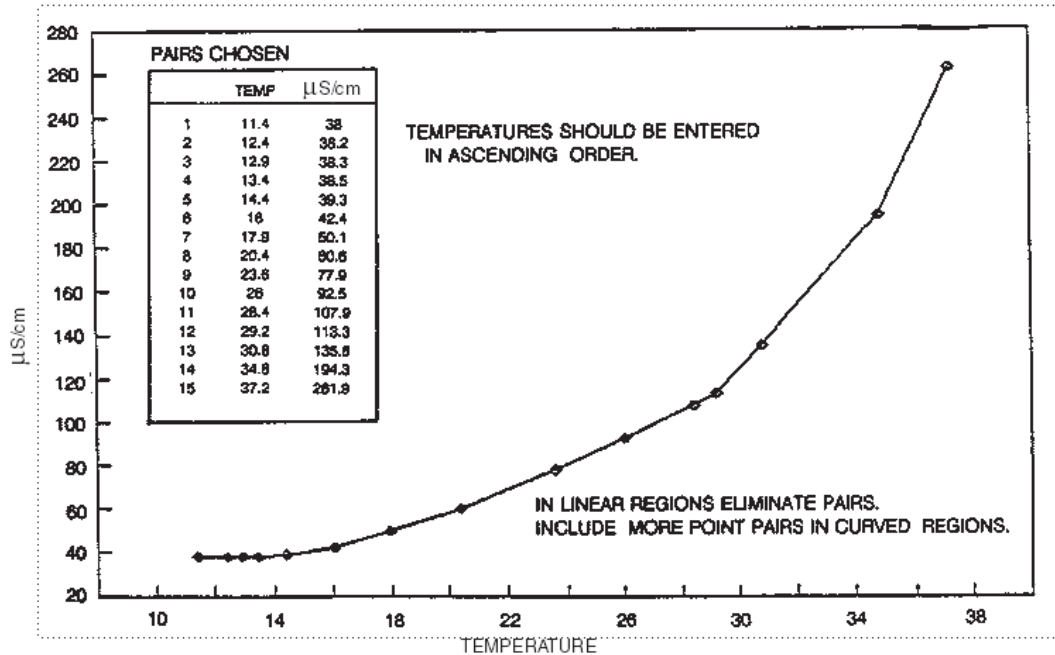
In the example used in Figure 19 and Figure 20, the 35 reference points were reduced to 15 configured points. The configuration procedure would have been as follows:

1. Specify the reference temperature. For this example, 25°C.

2. Specify the number of points on your curve. For this example, 15.

3. Specify the fifteen point pairs.

Measurement Unit Configured MΩ•cm

If `Meas Units` was configured as MΩ•cm, you are first asked to specify an `Absolute`, `Cation`, `Linear`, H₃PO₄, CH₃COOH, `Ultra Pure` H₂O, `Ammonia`, `Morpholine`, or `Custom` temperature compensation.

`Absolute` This selection means that there is no temperature compensation applied. The displayed value can exceed the scale by approximately five times (5X).

`Cation` See explanation above.

`Linear` See explanation above.

H₃PO₄ See explanation above.

CH₃COOH See explanation above.

`Ultra Pure` H₂O See explanation above.

`Ammonia` See explanation above.

`Morpholine` See explanation above.

`Custom` See explanation above.

Analog Out (PV), A# Analog Out (PV)

Refer to Figure 33.

This section of the structure enables you to specify what measurement the analog output reflects, the minimum and maximum range values for the output just specified. It also enables you to specify the measurement for the HART secondary, tertiary, and quaternary measurements.

First, specify `AO Source Measurement` as `Measurement`, `Temperature`, `Absolute`, `Concentration`, or `ATC Resistance`.

> **NOTE**
> Concentration is only available if measurement units was `%` or `Custom`.

Next, in `Low Value` enter the value of that measurement that produces an output of 4 mA and in `Upper Value`, the value of the measurement that produces an output of 20 mA. The lower and upper values must differ by a minimum amount. That minimum span amount is 0.4% of instrument range. Maximum turndown is 100% of selected display format.

Then specify the measurements of `HART SV`, `HART TV`, and `HART QV` as `Measurement`, `Temperature`, `Absolute`, `Concentration`, or `ATC Resistance`. The secondary measurement is frequently configured to temperature, the tertiary measurement to Absolute, and the quaternary measurement (if used) to ATC Resistance.

Display Format, A# Display Format

Refer to Figure 34.

The Display Format section of the structure enables you to display one, two, or three measurements. Then you can specify what measurement you want on each line of the display.

In `Display Format`, first specify the number of measurements to be displayed by selecting `Single`, `Double`, or `Triple`. Then specify what measurement you want displayed on `Line 1`, `Line 2` (if Double or Triple), and `Line 3` (if Triple).

Figure 21. Measurement Display

1-Line Display

Measurements
345 mS/cm

2-Line Display

Measurements
345   **mS/cm** ———— Line 1
31.8   **degC** ———— Line 2

3-Line Display

Measurements
345 mS/cm ———— Line 1
Line 2 —— **25 degC**   **345 mS/cm**
———— Line 3
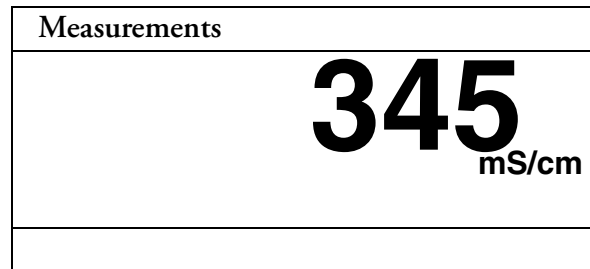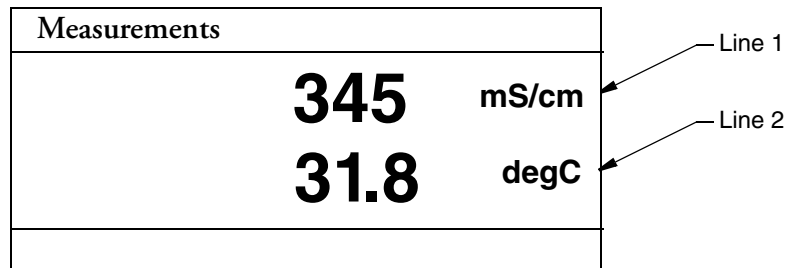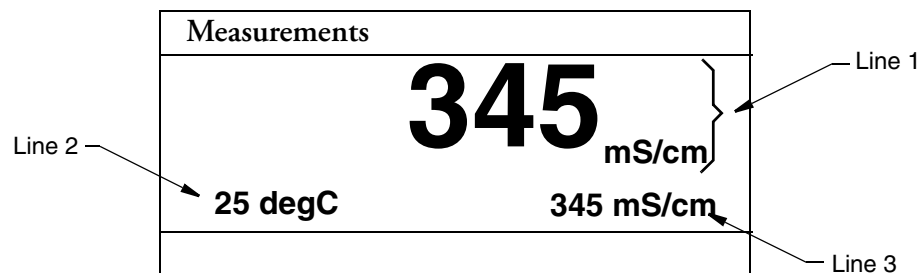
Run Apps

Refer to Figure 35.

── **NOTE** ──

1. This parameter appears only if the number of applications set in `Number of Apps` was greater than 1.

2. Each application must have been previously configured. Activating a nonconfigured application has no effect.

──

If, in using the transmitter, you wish to change from one application to another, you can specify the application number as `1`, `2`, or `3` in `Run Apps`. The entire application switches to that preconfigured application.

You can also specify `Auto` instead of an application number, and the analyzer switches from one application to another when triggered by measurements above or below established limits. Even though you may be measuring in other units, the high and low limits are always input in mS/cm.

♦ When the measurement value exceeds the `App 1 Hi` preset, `App 2` runs.

♦ When the value then exceeds the `App 2 Hi` preset, `App 3` runs.

♦ When the value decreases below the `App 3 Lo` preset, `App 2` runs.

♦ When the value decreases below the `App 2 Lo` preset, `App 1` runs.

If you specify `Auto`, you must establish the presets which trigger movement from one application to another. Therefore, specify the values of `App 1 Hi`, `App 2 Lo`, `App 2 Hi`, and `App 3 Lo`. These values must be entered in actual values and not in percent. It is assumed that although the ranges of the applications must overlap, application 1 has the lowest conductivity value, application 2 is next, and application 3 has the highest. The switching from one application to another only takes a few seconds. However, once a switch is made, another switch is not allowed for one minute.

AO Failsafe

Refer to Figure 36.

> **— NOTE —**
> The AO Failsafe parameter does not apply to multidrop communication.

A fail-safe output is delivered for those diagnostic failures that have been configured `On` as well as other failures. The AO Failsafe section of the structure enables you to specify the analog output under these fault conditions.

In AO Failsafe, select `Fail Low` to drive the analog output to 3.6 mA; select `Fail High` to drive the analog output to 22 mA; select `Off` to disable this feature (continues to follow the measurement). If `Off` is selected, you can continue to monitor failures using the HART protocol.

> **⚠ CAUTION**
> It is recommended that this feature be configured to protect your process in case of a fault.

HART Digital

Refer to Figure 37.

The HART Digital section of the structure enables you to set parameters for HART communication.

In `Poll Address:`

Enter a number from 0 through 15 if using HART Version 5.

> **— NOTE —**
> In HART Version 5, address 1 through 15 is reserved for multidrop.

Enter a number from 0 through 63 if using HART Version 6 or 7.

If using HART Version 6 and 7, enter the `mA Loop Mode` as `Active` or `Multi-Drop`.

`Preambles`, the number of preambles (5 to 20) to be sent in a response message from the transmitter to the host, are read only.

In `HART Version`, enter the version of the firmware being used.

NOTE

The Device Description (DD) must match the HART firmware version.
HART 5 - - - DD ≤ 14033F
HART 6 - - - DD ≥ 140340
HART 7 - - - DD ≥ 14140380

Diagnostics

Refer to Figure 38.

This section of the structure allows you to configure fault messages that can appear on your display. In `Diagnostics`, you can elect to `Enable All` or `Disable All` of the diagnostics or each of the following individually: `Leakage`, `ATC Short`, `ATC Open`, `Comp Range`, `Meas Range`, `USP645`, and `4-20 mA Range`. Each of these is discussed below. A typical approach is to initially disable all of the messages and to enable selected messages later when you find out that you require them. A fault symbol is displayed if a particular diagnostic is enabled and the fault occurs. If the diagnostics detects a failure, the analog output goes to the failsafe value if `AO Failsafe` was configured `On`.

Leakage

This diagnostic reports a problem of severe liquid leakage into the sensor which causes an ATC short to solution ground. The diagnostic can be enabled or disabled.

ATC Short, ATC Open

This diagnostic reports a problem if the resistance of the temperature compensator is greater or less than the expected resistance of the device configured. The diagnostic for each can be enabled or disabled.

Comp Range

This diagnostic reports that the measurement is outside the range configured for the currently running application. The diagnostic can be enabled or disabled.

Meas Range

This diagnostic reports that the measurement tied to the analog output is outside the range configured for the currently running application. The diagnostic can be enabled or disabled. An `Analog out of Range` message is displayed if this diagnostic is enabled and this fault occurs.

USP645 Overrange

The USP645 Overrange diagnostic is for users who are processing pharmaceutical water. The instrument should be used in the Absolute (no temperature compensation) mode. If the absolute conductivity exceeds the value in Table 9 at the corresponding temperature, the instrument will indicate this diagnostic. This diagnostic can be enabled or disabled.

Table 10. Maximum USP645 Conductivity Values

Temperature °C	Max USP Conductivity (μS/cm)	Temperature °C	Max USP Conductivity (μS/cm)	Temperature °C	Max USP Conductivity (μS/cm)
0	0.6	35	1.5	70	2.5
5	0.8	40	1.7	75	2.7
10	0.9	45	1.8	80	2.7
15	1.0	50	1.9	85	2.7
20	1.1	55	2.1	90	2.7
25	1.3	60	2.2	95	2.9
30	1.4	65	2.4	100	3.1

Auto Hold

Refer to Figure 39.

The Auto Hold section of the structure enables you to use the automatic hold parameter to automatically activate the Hold feature each time you enter Calibration or Configuration mode. In Auto Hold, select `On Present` to hold all values and states at their current level; `On Manual` to set all values and states at desired levels; or `Off` to omit this feature.

> — **NOTE** —
> If you select `On Manual`, you must go to Hold mode to set the values.

Config Timeout

Refer to Figure 40.

The Config Timeout section of the structure enables you to specify the time in which the instrument brings you back to the Measure mode from another mode when no keyboard input has occurred. In Measure mode, `Timeout` also limits the time to view a display other than that configured in "Display Format, A# Display Format" on page 50 that has been temporarily scrolled into view. Timeout can be configured to `Always Timeout`, timeout in online modes only (`Online Only`) or `Never Timeout`. The `Always Timeout` selection is recommended.

The timeout can be configured separately for front panel (`Front Panel`) and (`HART Communications`) operation. The time can be specified from 30 through 999 seconds.

Transmitter Tags

Refer to Figure 41.

The Transmitter Tags section of the structure enables you to enter tags to identify your transmitter. Each can have a maximum number of characters as described below. When you have finished entering a tag, press ENTER. These identifications appear in Status mode. For details on entering various characters, see page 26.

Table 11. Transmitter Tags

Tag Name	Characters
HART Message	32
HART Tag	8
HART Long Tag	32
HART Descriptor	16
Tag Name	14
Location	14
Device Name	6

Passcode Access

Refer to Figure 42.

The Passcode Access section of the structure enables you to limit access to change and/or view various parameters in the firmware. There are two Passcodes; Administrator Code and User Code. A person possessing the Administrator Code can change and view all parameters as well as establish what a person with User Code can access. A person with a User Code can only change and view what the administrator has allowed. Both codes are four digit codes.

> **NOTE**
> 1. The initial factory default value for both Administrator and User passcodes is 0800.
> 2. To bypass the passcode, the administrator must configure a passcode of 0000.

The configuration of this section is done in four steps.

1. In Admin Code, enter the four digit administrator code from 0 through 9999.

2. In User Code, enter the four digit user code from 0 through 9999.

3. In User Change, you can elect to enable (On) or disable (Off) user access to each of the following parameters.

Calibrate	Temp Comp	Apps Config
Analog Out Calib	PV Config	Tags Config
Hold	Meas Config	Timeouts
Suspend Fault	Display Config	Default Config
Resume Fault	Diag Config	Save Config
Clear History	HART Config	

> **NOTE**
> You can also make one selection to configure access to all the User Change parameters On or Off.

4. In User View, you can elect to enable (`On`) or disable (`Off`) user access to each of the following parameters.

Analog Out Cal	Diags	Xmtr Tags
Temp Comp	HART	Timeouts
Temp Table	Multi Apps	Default

— **NOTE** —
You can also make one selection to configure access to all the User Change parameters On or Off.

Stability

Refer to Figure 43.

The `Stability` parameter sets the measurement and temperature stability. It can be set from 25 through 1000%. 25% produces the most stable measurement and temperature measurements. Therefore it causes the longest calibration time. 100% is recommended for new installations.

Restore Configuration

Refer to Figure 44.

Configuring your transmitter involves the setting of many parameters specific for the application. You can configure up to three applications for each profile. In some cases, you may wish to employ the transmitter for more than one application (at different times). Rather than having to change several parameters, the 876CR allows you to save up to two unique and complete configuration profiles including the calibrations associated with these profiles. Either of these two profiles can be restored at any time to facilitate a quick and easy change of the transmitter to a presaved configuration. In addition to the two user profiles, the transmitter also includes a "factory default" configuration which allows you to return the transmitter to its original factory configuration at any time.

In `Restore Config`, select `Restore User 1`, `Restore User 2`, or `Restore Factory` and at the question `Restore User 1 Configuration?`, `Restore User 2 Configuration?`, or `Restore Factory Configuration?`, answer `Yes` or `No`.

Diagnostic Mode

Refer to Figure 23.

The Diagnostic mode enables you to:

♦   View active faults

♦   View history log

♦   Suspend faults for one hour

♦   Resume any suspended faults

♦   Save two user configurations

To enter the Diagnostic mode, press the `FUNCTION` key and then the `DIAG` key. Press `ENTER`. The display returns to Measure mode when you press the `FUNCTION` key and then the `MEASURE` key or when the timeout period expires. If there are no key presses within the configured Timeout period, the transmitter reverts to Measure mode and the outputs remain on hold.

View Faults

Select `View Faults` to view the most severe fault. Use the Up and Down arrow keys to view other faults. Four pieces of information are given for each fault: The type of fault, the severity of the fault, the fault itself, and a factory code (used only to help our Global Customer Support Center identify the cause if you call for help). See Figure 22. If there are no faults, the display reads `No Active Faults`.

Figure 22. Sample View Faults Display
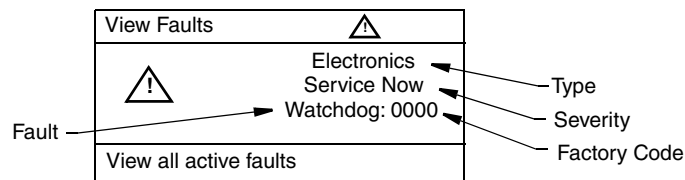
Table 12. List of Possible Faults

Type	Fault	Severity	Corrective Action	Suspendable
Electronics	Analog Calibration Lost	Failed	Contact our Global Customer Support Center	No
	Front End Communications	Service Now		No
	Meas Calibration Lost	Failed		No
	Memory Failure	Most Severe		No
	Memory Write Failure	Most Severe		No
	Operating System	Most Severe		No
	Processor Registers	Most Severe		No
	RAM Failure	Most Severe		No
	Software Failure	Most Severe		No
	Solution Ground Potential	Failed		No
	Temp Calibration Lost	Failed		No
	Watchdog Failure	Most Severe		No
	Elec. T to factory	Service Now	Return to factory	No
	Flash	Failed	Return to factory	No
Config	Temp Comp Table	Failed	Reconfigure Temp Comp Settings. See page 45.	No
Sensor	Analog out of range	Failed	Reconfigure analog output settings.	Yes
	ATC Open Circuit	Failed	1.Check ATC wiring and configuration. 2. Replace sensor	Yes
	ATC Short Circuit	Failed	1.Check ATC wiring and configuration. 2. Replace sensor	Yes

Table 12. List of Possible Faults (Continued)

Type	Fault	Severity	Corrective Action	Suspendable
	Measurement Overflow	Failed	Contact our Global Customer Support Center	No
	Sensor Leaking	Failed	Replace sensor.	Yes
	Temperature Overflow	Failed	1. Check ATC wiring and configuration. 2. Replace sensor.	Yes
	Temp Comp Overrange	Service Now	Reconfigure temp comp settings.	Yes
	Temp Sensor 3rd Wire	Service Now	1. Check ATC configuration 2. Connect 3rd wire of temp sensor	Yes
	USP 645 Maximum Exceeded	Service Now	Check Process	Yes
Calib	Calibration Required	Service Now	Perform measurement calibration.	No
	Out of Range		Check Sensor wiring	No

View History Log

Select `History` Log and press `ENTER` to view or erase the diagnostic history logs. Use the Up and Down arrow keys to select All History Logs, Calibration Log, Error Log, Operation Log. You can also select Clear History; however clearing the history log requires entering your passcode.

Suspend or Resume Faults

Select `Suspend Faults` to suspend the present faults for one hour. The display asks for your passcode. An incorrect passcode returns you to the start of the Diagnostic menu. A correct passcode causes the prompt `Suspend Fault?` to be displayed. If you answer `Yes`, the message `Faults Suspended` is displayed. After either a `Yes` or `No` reply, the Diagnostic menu is displayed. Each suspended fault is inhibited from reoccurring for one hour from the time the Diagnostic mode is entered.

The faults listed in Table 12 as "Suspendable" can be suspended and resumed as necessary. Select `Suspend Faults` to suspend the present faults for one hour.

Select `Resume Faults` to resume all suspended faults.

Save User Configuration

Configuring your transmitter involves the setting of many parameters specific for the application. In some cases, you may wish to employ the transmitter for more than one application (at different times). Rather than having to change several parameters, the 876CR allows the user to save up to two unique and complete configuration profiles including the calibrations associated with these profiles.

Either of these two profiles can be restored at any time to facilitate a quick and easy change of the transmitter to a presaved configuration. See "Restore Configuration" on page 56.

Select `Save Config 1` or `Save Config 2` to save your configuration. The display asks for your passcode. An incorrect passcode returns you to the start of the Diagnostic menu. A correct

passcode causes the prompt `Save Config #?` to be displayed. If you answer `Yes`, the message `Configuration Saved` is displayed. If you answer `No`, the message displayed is `Action Cancelled`.

Figure 23. Diagnostic Mode Structure
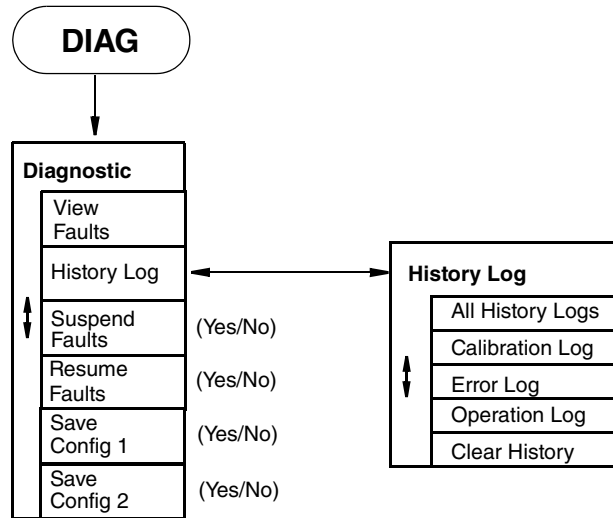
6. Operation Via HART Communicator

1. For HART communications, a 250 Ω load resistor must be present in the power supply loop.

2. For proper communication with a HART Communicator, the communicator must contain the proper DD for the 876CR Transmitter. This DD is available from our website or any other authorized HART Foundation source.

3. If the DD shows "access restricted", start over and re-enter the passcode.

Entering Modes

From the Home menu, select the mode to be entered. If `Save to Xmtr` appears, it must be handled before entering a different mode. If a passcode is required, select `Enter Passcode` before accessing a new mode.

Saving Changes

Changes must be saved before going to another mode.

If the `Send` soft key appears on the screen, it must be pressed before saving changes.

Press `Home`, select `Save to Xmtr`. Answer the `Save changes?` question by selecting `Yes` or `No`, and pressing `ENTER`. If errors exist, the `Fix Errors?` question appears. A `No` response discards all changes; An `Yes` response provides the title of the first parameter with a problem which must then be resolved.

—— NOTE ——
The `Save` soft key refers to a local communicator copy of the parameters, not the transmitter's `Save changes`.

HART Online Menu

Figure 24. 876CR Transmitter Online Menu Tree (1 of 2)

```
2 Online
 │
 ├── 1 MEASUREMENT ──── 1 Measurement
 │                       2 Temperature
 │                       3 Absolute
 │                       4 Analog Output
 │                       5 HART PV
 │                       6 HART SV
 │                       7 HART TV
 │                       8 HART QV
 │
 │                                                                  1 ATC Resistance
 │                                                                  2 ATC Status
 ├── 2 DIAGNOSTICS ──── 1 Diagnostics ──── 1 View Faults           3 Temperature
 │                                          2 History Log            4 Temp Status
 │                                          3 Suspend Faults         3 Absolute
 ├── 3 CONFIGURE ──────                     4 Resume Faults          5 Absolute Status
 │                       1 Configure        5 Save Config 1          6 Temp Sensor
 │                                          6 Save Config 2          7 T Sensor Status
 │                                                                   8 Measurement
 ├── 4 STATUS ───────── 1 Status ──────────────────────────────────9 Meas Status
 │                                                                     Calibrated By
 │                                                                     Calib Date
 │                                                                     Analog Output
 ├── 5 CALIBRATE ────── 1 Calibrated By                               Analog Output Status
 │                       2 Calibrate ──── mA Cal
 │                                        Measurement                 HART PV
 │                                        Temperature                 PV Status
 │                                                                     HART SV
 │                                                                     SV Status
 │                                                                     HART TV
 │                                                                     TV Status
 │                                                                     HART QV
 │                                                                     QV Status
 ├── 6 HOLD XMTR OUTPUT ── Off                                        Model Code
 │                          Present                                   Sales Order
 │                          Manual                                    Xmtr Serial Number
 │                                                                     Firmware Revision
 │                                                                     Front End Revision
 │                                                                     Boot Revision
 └── 7 DD Revision                                                    Transmitter Type
                                                                      In Service
                                                                      HART Tag
                                                                      HART Long Tag
                                                                      Tag Name
                                                                      Location
                                                                      Device Name
                                                                      HART Descriptor
                                                                      HART Message
```

Figure 25. 876CR Transmitter Online Menu Tree (2 of 2)

CONFIGURATION

1 Sensor

1 Measurement 2 Temp Type

6 Meas Display

1 Display Format 2 Line 1 3 Line 2 4 Line 3

7 AO Failsafe

Off Fail Low Fail High

8 HART Digital

1 Poll Address 2 Preambles 3 HART Version

9 Diagnostics

1 Enable/Disable Diag

2 Meas Config

1 Meas Units 2 Base Display Scale 3. Damping

Auto Hold

Off On Present On Manual

3 Temp Config

1 Temp units 2 Temp Mode 3 Manual Temp   or Fail Temp

Timeout

1. Timeout

4 Temp Comp

Absolute NaCl KCl Cation Linear H3PO4 CH3COOH Ammonia Morpholine Ions Only Custom Ultra Pure Water

Transmitter Tags

1 HART Message 2 HART Tag 3 HART Descriptor 4 Tag Name 5 Location 6 Device name

Passcode Access

1 Admin Code 2 User Code 3 User Change 4 User view

Cal parameters

1 Buffer Set 2 Stability

5 Analog Out

1 AO Source 2 Lower Value 3 Upper Value 4 HART SV 5 HART TV 6 HART QV

Restore Config

1 Restore User 1 2 Restore User 2 3 Restore Factory

Explanation of Parameters

> **NOTE**
>
> 1. The fast-key path shown is based on a frequently used configuration. If certain parameters are configured off or infrequently used parameters configured on, the fast-key path may be different.
>
> 2. For more detailed explanation of parameters, see "Operation Via Local Display" on page 25.

Parameter	Fast-Key Path	Explanation
Measurement Mode		
Absolute	1,3	Displays the absolute (uncompensated) measurement value.
Analog Output	1,4	Displays the analog output in mA.
HART PV	1,5	Displays the HART primary value.
HART QV	1,8	Displays the HART fourth value.
HART SV	1,6	Displays the HART secondary value.
HART TV	1,7	Displays the HART tertiary value.
Measurement	1,1	Displays the measurement (PV) value.
Temperature	1,2	Displays the temperature value in specified engineering units.
Diagnostic Mode		
History Log	2,2	Used to view or erase one or more diagnostic history logs.
Resume Faults	2,4	Used to resume suspended faults.
Save Config 1	2,5	Used to save your configuration.
Save Config 2	2,5	Used to save your configuration.
Suspend Faults	2,3	Used to suspend faults for one hour.
View Faults	2,1	Displays the most severe fault and other faults if desired.
Configure Mode		
Sensor	3,1	Path to sensor related parameters.
Measure Config	3,2	Path to measure related parameters.
Temp Config	3,3	Path to temperature related parameters.
Temp Comp	3,4	Used to specify temperature compensation as Standard, Ammonia, or Custom.
Analog Out (PV)	3,5	Path to analog output related parameters.
Meas Display	3,6	Path to display related parameters.
AO Failsafe	3,7	Used to specify the analog output under fault conditions.
HART Digital	3,8	Path to HART related parameters.
Diagnostics	3,9	Path to diagnostic related parameters.
Auto Hold		Used to configure all values and states to be held at their current level (On Present), at a desired level (On Manual) when triggered by a digital signal or when going into Calibration or Configuration mode. Select Off to omit this feature.
Config Timeout		Used to specify the time in which you are returned to Measure mode when no keyboard input has occurred.
Transmitter Tags		Path to tag related parameters.
Passcode Access		Path to passcode related parameters.
Cal Parameters		Path to calibration related parameters.
Restore Config		Path to restoring the transmitter to a user stored or the factory configuration.

Parameter	Fast-Key Path	Explanation
Measurement	3,1,1	Select the type of measurement.
Damping		Enter the damping response time.
Temp Units	3,3,1	Select Temp Units as °C or °F.
Temp Mode	3,3,2	Select the Temp Mode as Auto or Manual.
Manual Temp	3,3,3	If Temp Mode is Manual: Enter a fixed temperature.
Fail Temp	3,3,3	If Temp Mode is Auto: Enter a temperature fail signal value.
AO Source	3,5,1	Select the AO Source from the picklist provided.
Lower Value	3,5,2	Enter the measurement value that is to produce 4 mA.
Upper Value	3,5,3	Enter the measurement value that is to produce 20 mA.
HART SV	3,5,4	Select the SV measurement from the picklist provided.
HART TV	3,5,5	Select the TV measurement from the picklist provided.
HART QV	3,5,6	Select the QV measurement from the picklist provided.
Display Format	3,6,1	Select the Display Format as Single, Double, or Triple.
Line 1	3,6,2	Select the measurement to be displayed on Line 1.
Line 2	3,6,3	Select the measurement to be displayed on Line 2.
Line 3	3,6,4	Select the measurement to be displayed on Line 3.
Poll Address	3,8,1	Enter the polling address to a number from 0 through 15. A nonzero number specifies multidrop applications.
Preambles	3,8,2	Displays the number of preambles to be sent in a response message from the transmitter to the host.
HART Version	3,8,3	Used to specify the HART version.
Enable/Disable Diag	3,9,1	Turn On or Off the various diagnostics.
HART Message		Enter a HART Message (32 characters maximum).
HART Tag		Enter a HART Tag (8 characters maximum).
HART Descriptor		Enter a HART Descriptor (16 characters maximum).
Tag Name		Enter a Tag Name (14 characters maximum).
Location		Enter a Location (14 characters maximum).
Device Name		Enter a Device name (6 characters maximum).
Admin Code		Enter a 4-digit Administrator Code.
User Code		Enter a 4-digit User Code.
User Change		Turn On or Off the various parameters the user is allowed to change.
User View		Turn On or Off the various parameters the user is allowed to view.
Buffer Set		Select the Buffer from the picklist provided.
Stability		Enter a value (%) for measurement/temperature stability.
Restore User 1		Enables you to restore a saved user configuration.
Restore User 2		Enables you to restore a saved user configuration.
Restore Factory		Enables you to restore the factory configuration.
Status Mode		
Temperature	4,1,1	Displays the temperature measurement
Temp Status	4,1,2	Displays the status of the temperature measurement
Absolute	4,1,3	Displays the absolute measurement
Absolute Status	4,1,4	Displays the status of the absolute measurement
Temp Sensor	4,1,5	Displays the temperature sensor resistance
T Sensor Status	4,1,6	Displays the status of the temperature sensor
Measurement	4,1,7	Displays the measurement
Meas Status	4,1,8	Displays the status of the measurement
Calibrated By		Displays the name of the last operator

Parameter	Fast-Key Path	Explanation
Calib Date		Displays the date of last calibration (dd/mm/yyyy)
Lo Cal Point		Displays values at the lower calibration point
Hi Cal Point		Displays values at higher calibration point
Analog Output		Displays the value of the analog output
Analog Output Status		Displays the status of the analog output
HART PV		Displays the HART primary value
PV Status		Displays the status of the HART primary value
HART SV		Displays the HART secondary value
SV Status		Displays the status of the HART secondary value
HART TV		Displays the HART tertiary value
TV Status		Displays the status of the HART tertiary value
HART QV		Displays the HART fourth value
QV Status		Displays the status of the HART fourth value
Model Code		Displays the transmitter model code
Sales Order		Displays the transmitter sales order number
Xmtr Serial Number		Displays the analyzer serial number
Firmware Revision		Displays the firmware revision level
Front End Revision		Displays the front end revision level
Boot Revision		Displays the boot revision level
Transmitter Type		Displays the transmitter type (876CR)
In Service		Displays the time in service in days
HART Tag		Displays the HART Tag name
HART Long Tag		Displays the HART Long Tag name (versions 6 and 7)
Tag Name		Displays the tag name
Location		Displays the location of the measurement
Device Name		Displays the device name
HART Descriptor		Displays the HART descriptor
HART Message		Displays the HART message
Calibrate Mode		
Calibrated By	5,1	Enter the name of the person calibrating the device and the date of calibration.
Calibrate	5,2	Path to calibrating parameters.
mA Cal		Used to perform a mA Cal calibration.
Measurement		Used to perform a measurement calibration.
Temperature		Used to perform a temperature calibration.
Hold Xmtr Output		
Off		Used to release the transmitter from Hold state.
On Present		Used to hold all values and states at their current level.
On Manual		Used to hold all values and states at desired levels.
DD Revision		Displays the DD Revision level.

7. Maintenance

This product contains components that have critical safety characteristics. **Do not** substitute components. Replace components only with identical factory supplied components. Component substitution may impair the electrical safety of this equipment and its suitability for use in hazardous locations.

The maintenance of the 876CR Transmitter is limited to replacement of the bezel/keypad assembly, the display printed wiring assembly (PWA), the processor PWA and the loop power (MAU) PWA. Attempts to repair printed wiring assemblies could result in damage and voiding of the warranty. The recommended repair procedure is return of the transmitter to the factory for repair. For additional information, refer to PL 611-260.

To replace parts, refer to Figure 26.

Figure 26. Exploded View of 876CR Transmitter

SAFETY COVER
CAUTION LABEL

JUMPER LABEL
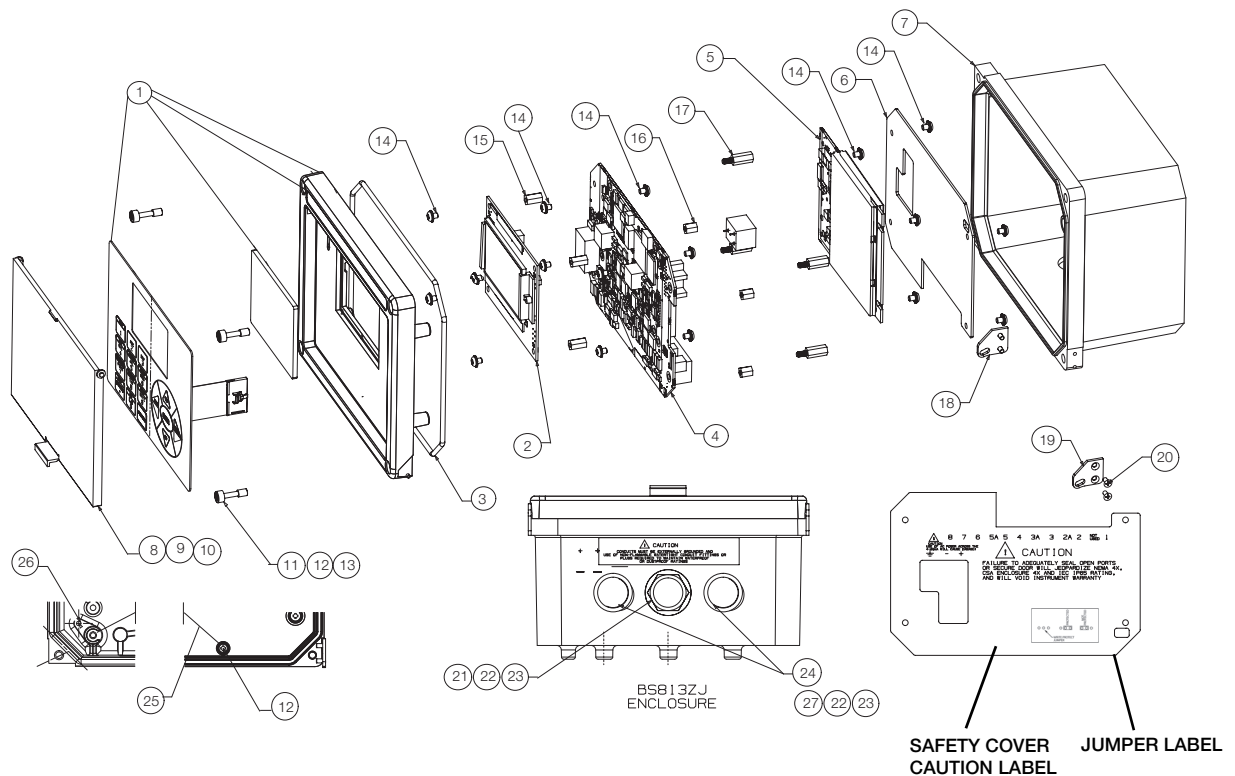
⚠ WARNING

Before replacing parts, be sure to turn power off.

NOTICE

This unit uses printed wiring assemblies with components that are **highly susceptible to damage from electrostatic discharge (ESD)**. Relatively low static potential can rupture sensitive components resulting in degraded device characteristics or failure. All printed wiring assemblies **must** be handled with the user grounded via a conductive wrist strap (between 100 Ω minimum and 1 MΩ maximum).

Replacing the Bezel/Keypad Assembly (Item 1)

1. Unscrew the four Screws (Item 11) on the corners of the bezel/keypad assembly and open the assembly downward.

NOTICE

The assembly does not open a full 180°. Do not press on it.

2. Remove four Screws (Item 14) and remove the Safety Cover (Item 6).
3. Remove four Standoffs (Item 17), disconnect the ribbon cable, and carefully lift off stack of boards.
4. Remove screw (Item 26) that secures the ground wire (Item 25) to the bezel/keypad assembly (Item 1).
5. Remove one of the two door Hinges (Item 18 or 19) by removing the two Screws (Item 20) that secure it. Remove the door.
6. Install the new door by reversing Steps 1 though 5.

⚠ CAUTION

When positioning stack of boards on the bezel/keypad assembly bosses, carefully fold the flex ground strap over the lower left boss.

Replacing the Loop Power (MAU) PWA (Item 5)

1. Unscrew the four screws (Item 1) on the corners of the bezel/keypad assembly and open the assembly downward.

NOTICE

The assembly does not open a full 180°. Do not press on it.

2. Disconnect wires from power terminals.
3. Remove four Screws (Item 14) and remove the Safety Cover (Item 6).
4. Remove the four Screws (Item 14) that secures the MAU PWA (Item 5) to the Standoffs (Item 16).
5. Grasping the MAU PWA on both sides, carefully lift it straight up and off.
6. Install the new MAU PWA by reversing Steps 1 though 5.

Replacing the Processor PWA (Item 4)

1. Remove the MAU PWA as described immediately above.

2. Disconnect wires from sensor terminals.

3. Remove the four Screws (Item 14) that secures the Processor PWA (Item 4) to the Standoffs (Item 15).

4. Remove four Standoffs (Item 17) and save them.

5. Carefully separate the Processor PWA (Item 4) and Display PWA (Item 7).

6. Remove the four Screws (Item 14) and Standoffs (Item 16) from the Processor PWA (Item 4) and save them.

7. Install the new Processor PWA by reversing Steps 1 though 6.

Replacing the Display PWA (Item 2)

1. Unscrew the four screws (Item 14) on the corners of the bezel/keypad assembly and open the assembly downward.

NOTICE

The assembly does not open a full 180°. Do not press on it.

2. Disconnect wires from power terminals.

3. Remove four Screws (Item 14) and remove the Safety Cover (Item 6).

4. Remove four Standoffs (Item 17), disconnect the ribbon cable, and carefully lift off stack of boards.

5. Remove the four screws (Item 14) that secures the Display PWA to Standoffs (Item 15).

6. Carefully separate the Processor PWA (Item 4) and Display PWA (Item 2).

7. Install the new Display PWA by reversing Steps 1 though 6.

Appendix A. Configuration Structure Diagrams

Figure 27. Configuration Top Level Structure

(a) If Number of Applications = 2 or 3
(b) If Number of Applications = 1
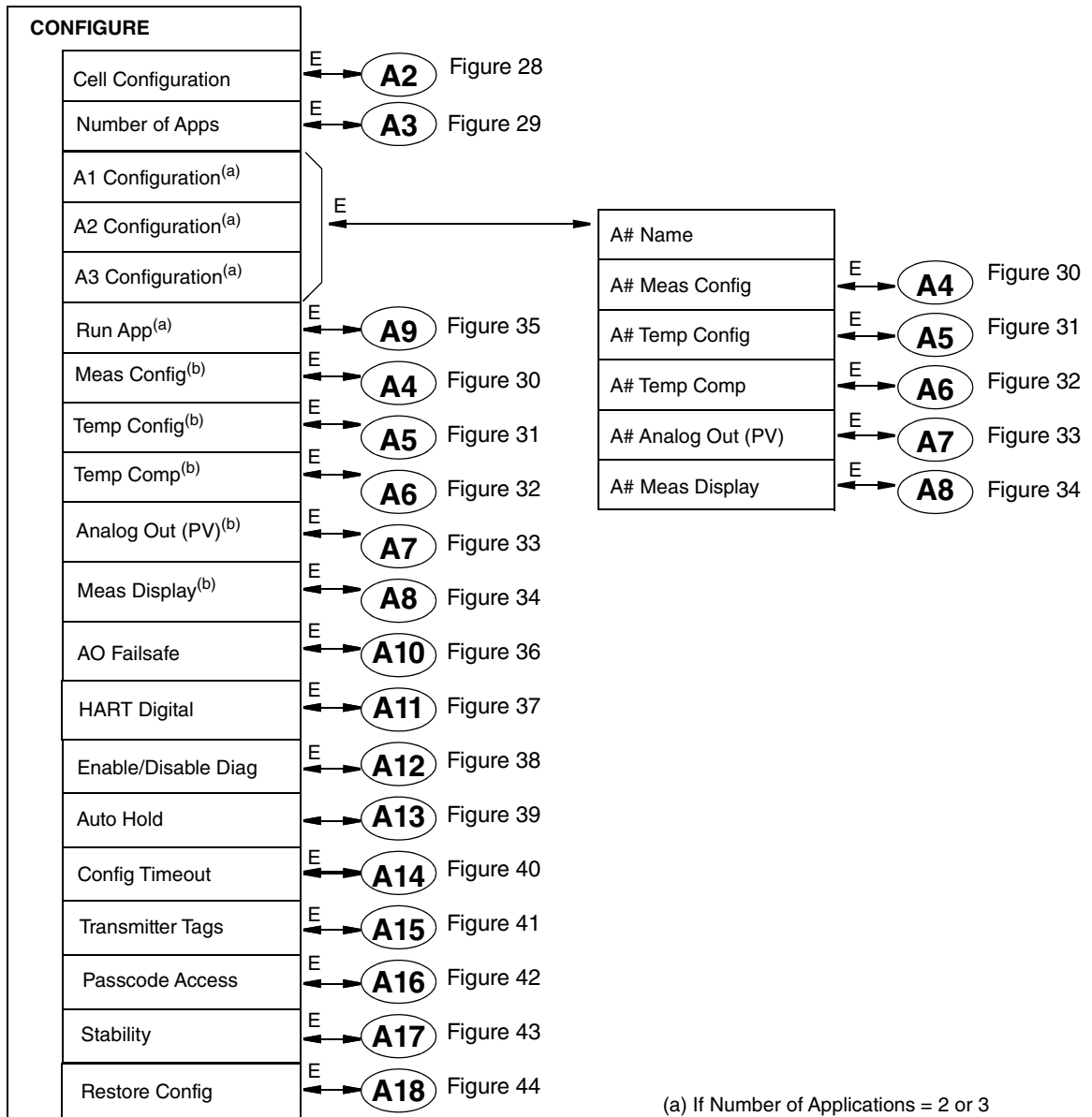
NOTE

Before entering Configuration mode, you must first enter a proper passcode. The factory default passcode is 0800.

Figure 28. Cell Configuration Structure
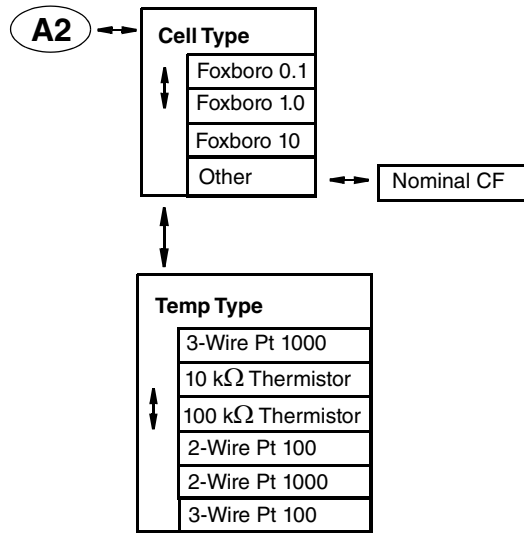
Figure 29. Number of Applications Configuration Structure
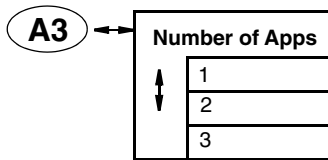
Figure 30. Measurement Configuration Structure
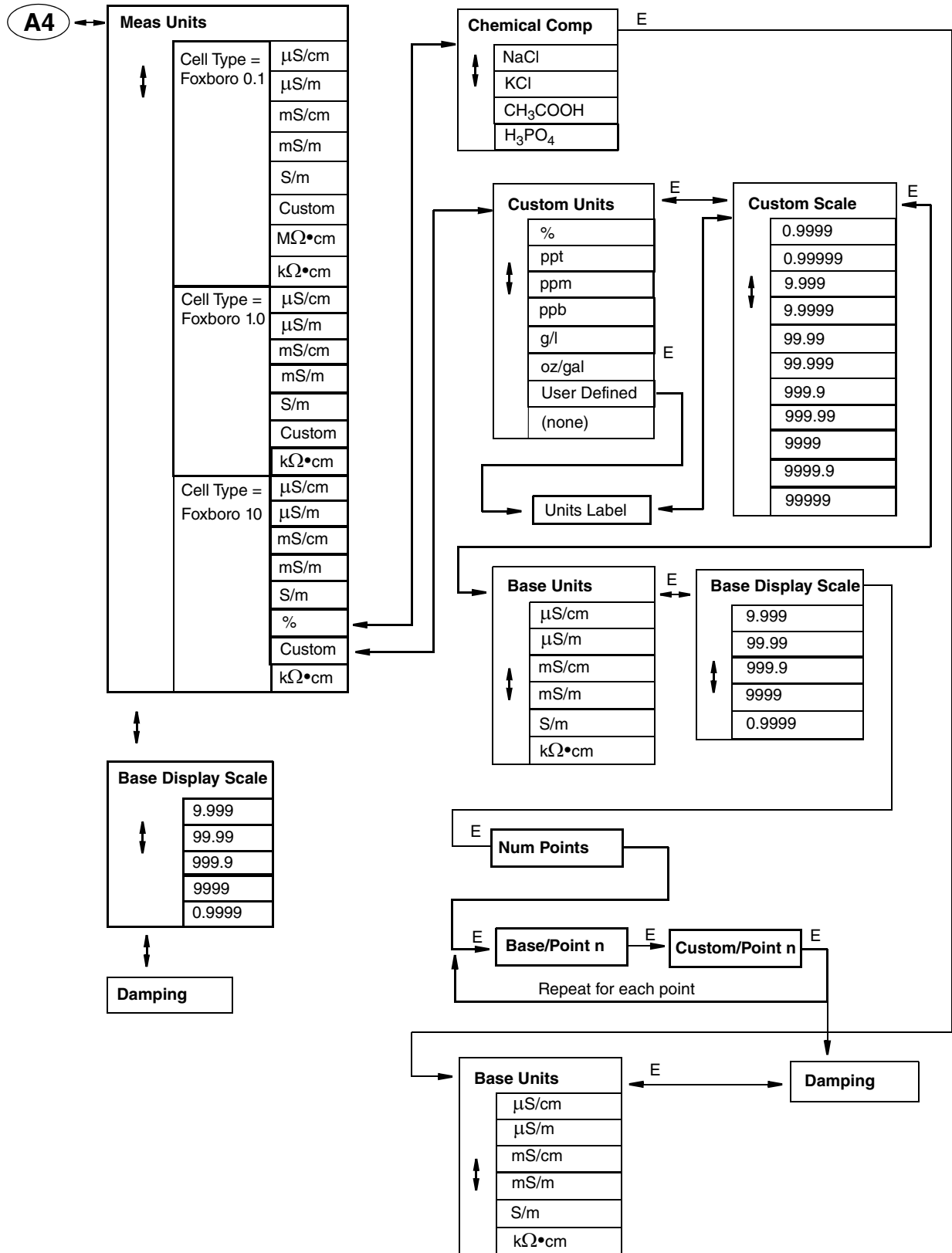
Figure 31. Temperature Configuration Structure
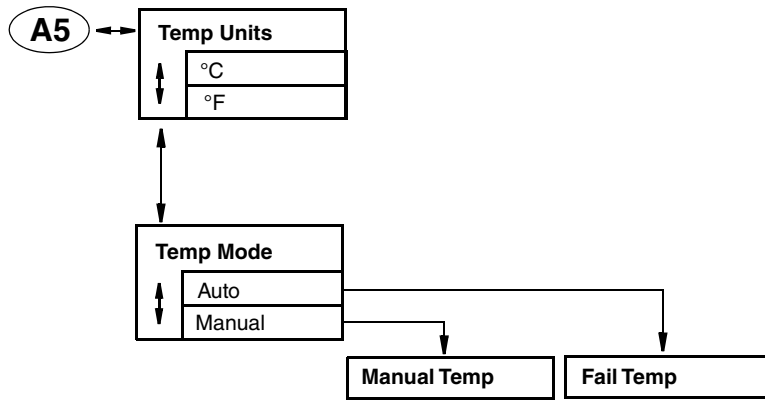
Figure 32. Temperature Compensation Structure
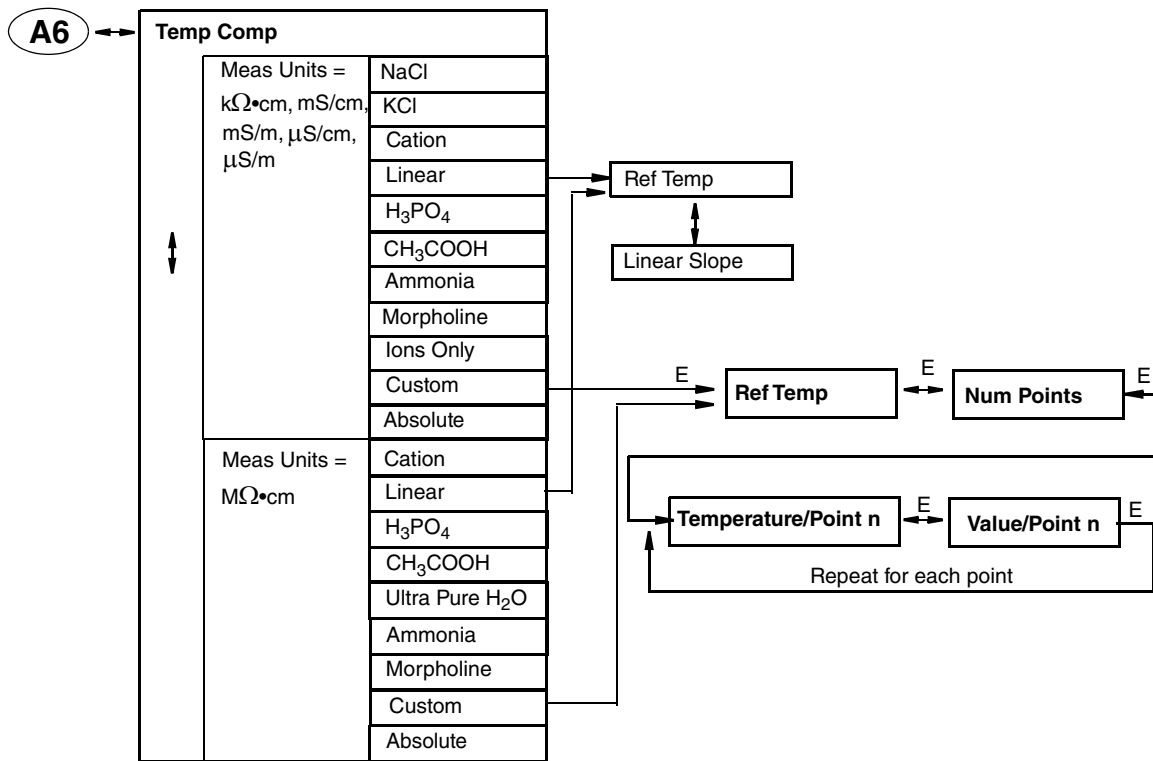
Figure 33. Analog Output Structure

A7 ↔ **AO Source Measurement**

Measurement
Temperature
Absolute
Concentration[(a)]
ATC Resistance
Cell Resistance

(a) Only when Meas Units is % or Custom

Low Value

Upper Value

HART SV

HART TV

HART QV
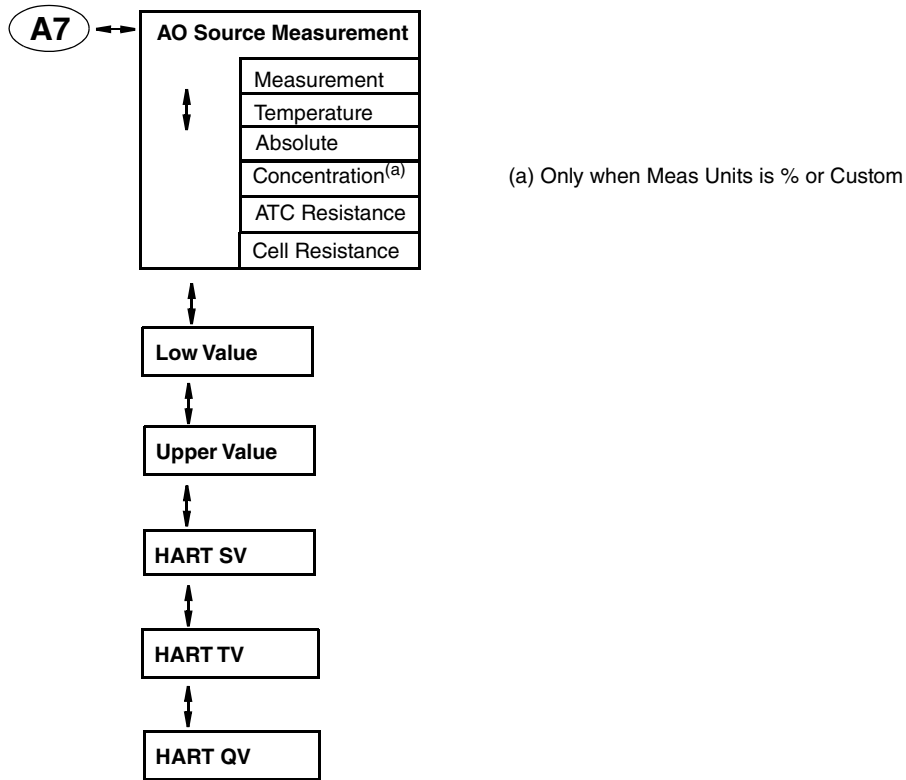
Figure 34. Measurement Display Structure

A8 ↔ **Display Format**

Double Line
Triple Line
Single Line

Line n

Measurement
Temperature
Absolute
Concentration[(a)]
Analog Out

(a) Only when Meas Units is % or Custom
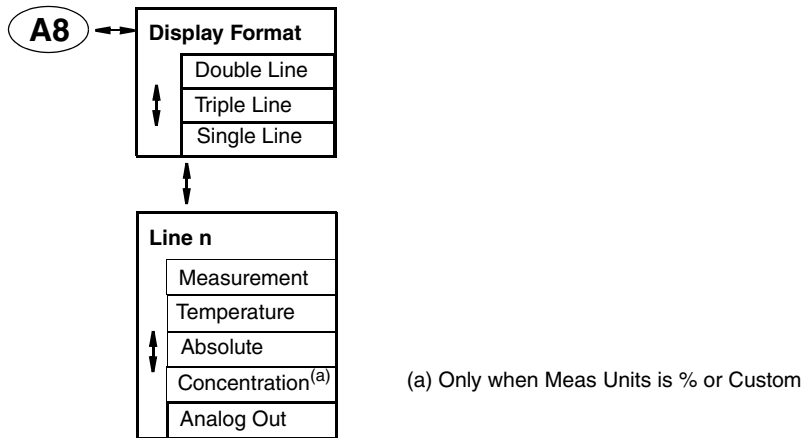
Figure 35. Run Application Structure

(a) If Number of Applications = 2 or 3
(b) If Number of Applications = 3
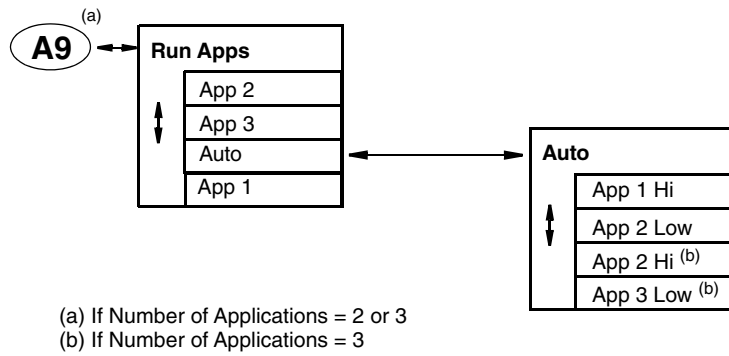
Figure 36. AO Failsafe Structure
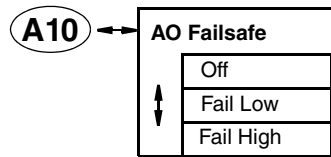
Figure 37. HART Digital Structure
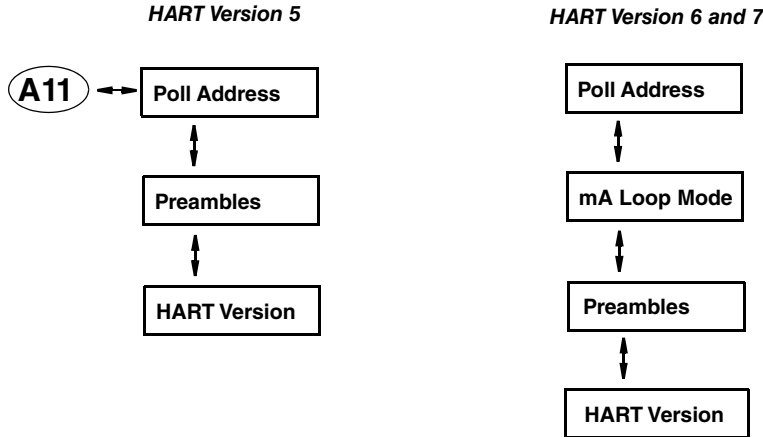
Figure 38. Diagnostics Structure
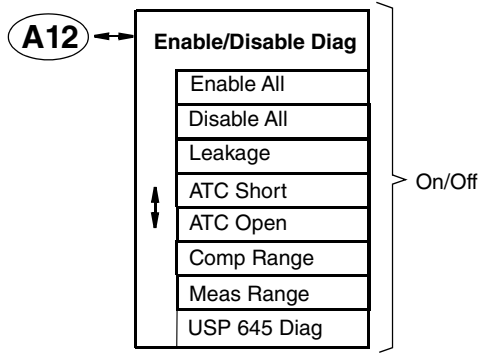
Figure 39. Auto Hold Structure
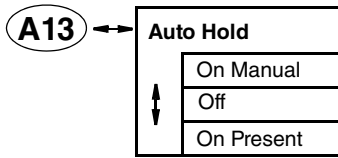
Figure 40. Timeout Structure
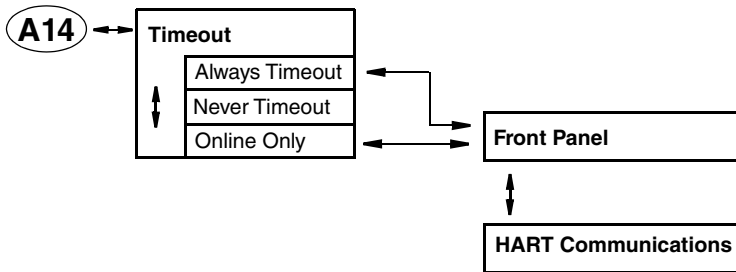
Figure 41. Transmitter Tags Structure

```
A15  ←→  ┌─────────────────┐
         │  HART Message   │
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │  HART Tag       │
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │ HART Long Tag (a)│      (a) If HART version = 6 or 7
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │ HART Descriptor │
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │  Tag Name       │
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │  Location       │
         └─────────────────┘
                 ↕
         ┌─────────────────┐
         │  Device Name    │
         └─────────────────┘
```
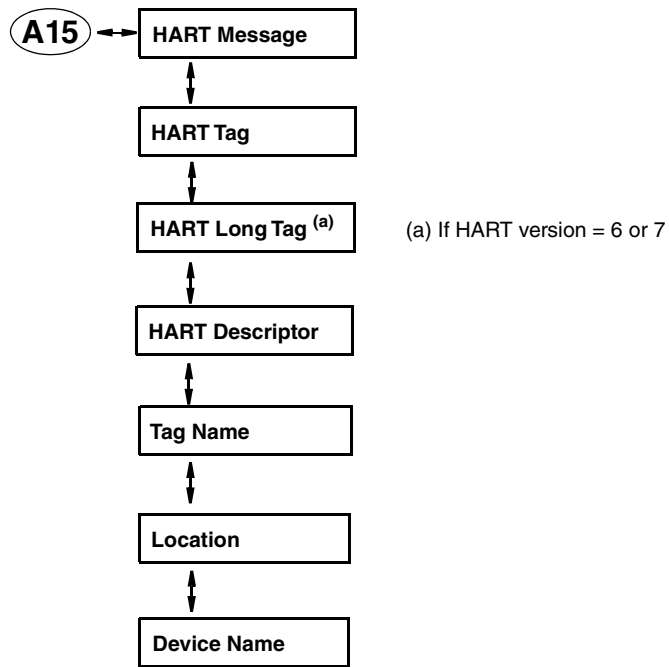
Figure 42. Passcode Access Structure

```
( A16 ) ◀▶ [ Admin Code ]
               ↕
           [ User Code ]
               ↕
```

User Change		User View	
Set All On		View All	
Set All Off		View None	
Calibrate		Cal Stability	
Cal Stability		Temp Comp	
Hold		Custom Tables	
Suspend Fault		Display	
Resume Fault		Diags	On/Off
Clear History		HART	
Temp Comp		Multi Apps	
Cell Cfg		Auto Hold	
PV Cfg		Xmtr Tags	
Meas Cfg	On/Off	Timeouts	
Display Cfg		Default	
Diag Config			
HART Cfg			
Apps Cfg			
Auto Hold			
Tags Cfg			
Timeouts			
Default Cfg			
Save Cfg			

Figure 43. Stability Structure

```
( A17 ) ◀▶ [ Stability ]
```

Figure 44. Restore Config Structure

```
  ┌────┐        ┌──────────────────┐
  │A18 │ ◄──►  │  Restore User 1  │   Yes/No
  └────┘        └──────────────────┘
                         ▲
                         │
                         ▼
                ┌──────────────────┐
                │  Restore User 2  │   Yes/No
                └──────────────────┘
                         ▲
                         │
                         ▼
                ┌──────────────────┐
                │  Restore Factory │   Yes/No
                └──────────────────┘
```
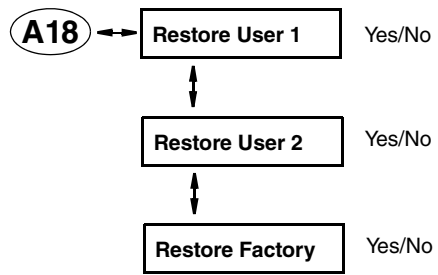
Appendix B. Configuration Table

This appendix contains information that helps you configure your transmitter. The information is presented in the form of a table containing each prompt/parameter, its limits, and its factory default value. It also provides space for you to record your specific configuration and notations.

─ **NOTE** ───
Bold print in the Factory Configuration column indicates the configuration resulting from the Configure Factory Defaults menu.

Identifies the structure diagram that contains a specific prompt/parameter

Limits of each parameter

Space for you to record your specific configuration

Prompts to parameters in the order in which they are displayed when you step through the menu structure

Standard factory configuration

Additional information and space for your notations

Figure	Prompt/Parameter	Parameter Limits	Factory Configuration	User Configuration	Remarks and Notes
A-1	Configure	Cell Configuration Number of Apps Meas Config Temp Config Temp Comp Analog Out (PV) Meas Display AO Failsafe HART Digital Enable/Disable Diag Auto Hold Config Timeout Transmitter Tags Passcode Access Stability Restore Config			
A-2	Cell Configuration				
	Cell Type	Foxboro 0.1, Foxboro 1.0, Foxboro 10, Other	Foxboro 0.1		
	Temp Type	3-Wire Pt 1000 10 kΩ Thermistor 100 kΩ Thermistor 2-Wire Pt 100 2-Wire Pt 1000 3-Wire Pt 100	3-Wire Pt 1000		
A-3	Number of Apps	1, 2, 3	1		

Figure	Prompt/Parameter	Parameter Limits	Factory Configuration	User Configuration	Remarks and Notes
A-4	Meas Config, A# Meas Config				
	Meas Units	μS/cm, μS/m, mS/cm, mS/m, S/m, %[a], Custom, M$\Omega\bullet$cm[b], k$\Omega\bullet$cm	μS/cm		[a] If Cell Type = Foxboro 10 [b] If Cell Type = Foxboro 0.1
	Base Display Scale	9.999, 99.99, 999.9, 9999, 0.9999	9.999		
	Damping	0 to 300 seconds	1 second		
	Chemical Comp	NaCl, KCl, CH_3COOH, H_3PO_4			If Meas Units = %
	Base Units	μS/cm, μS/m, mS/cm, mS/m, S/m, k$\Omega\bullet$cm			
	Custom Units	%, ppt, ppm, ppb, g/l, oz/gal, user defined, (none)	%		If Meas Units = Custom
	Custom Scale	0.9999, 0.99999, 9.999, 9.9999, 99.99, 99.999, 999.9, 999.99, 9999, 9999.9, 99999	0.9999		
	Base Units	μS/cm, μS/m, mS/cm, mS/m, S/m, k$\Omega\bullet$cm	μS/cm		
	Base Display Scale	9.999, 99.99, 999.9, 9999, 0.9999	9.999		
	Num Points	2 to 21	2		
	Base Point #				
	Custom Point #				
A-5	Temp Config, A# Temp Config				
	Temp Units	°C, °F	°C		
	Temp Mode	Auto, Manual	Auto		
	Manual Temp	-30.00 to 200.00°C	0.00°C		If Temp Mode = Manual
	Fail Temp	-30.00 to 200.00°C	25°C		If Temp Mode = Auto
A-6	Temp Comp, A# Temp Comp				
	Temp Comp	NaCl, KCl, Cation, Linear, H_3PO_4, CH_3COOH, Ammonia, Morpholine, Ions Only, Custom, Absolute	NaCl		If Meas units = k$\Omega\bullet$cm, mS/cm, mS/m, μS/cm, μS/m
		Cation, Linear, H_3PO_4, CH_3COOH, Ultra Pure H_2O, Ammonia, Morpholine, Custom, Absolute	Cation		If Meas Units = M$\Omega\bullet$cm
A-7	Analog Out (PV)				
	AO Source Measurement	Measurement, Temperature, Absolute, Concentration[a], ATC Resistance, Cell Resistance	Measurement		[a] If Meas Units = % or Custom
	Low Value	0.00000 to 10.00000	0		
	Upper Value	0.00000 to 10.00000	9.999		
	HART SV	Measurement, Temperature, Absolute, Concentration[a], ATC Resistance, Cell Resistance	Temperature		[a] If Meas Units = % or Custom
	HART TV		Absolute		
	HART QV		ATC Resistance		

Figure	Prompt/Parameter	Parameter Limits	Factory Configuration	User Configuration	Remarks and Notes
A-8	Meas Display				
	Display Format	Double Line, Triple line, Single Line	Double Line		
	Line 1	Measurement, Temperature, Absolute, Concentration, Analog Out	Measurement		
	Line 2		Temperature		If Display Format = Double Line or Triple Line
	Line 3		Absolute		If Display Format = Triple Line
A-9	Run Application				If Number of Apps = 2 or 3
	Run App	App 1, App 2, App 3, Auto	App 2		
A-10	AO Failsafe	Off, Fail Low, Fail High	Off		
A-11	HART Digital				
	Poll Address	0-15 (for HART Version 5) 0-63 (for HART Version 6, 7)	0		
	mA Loop Mode	Active, Multi-Drop	Active		If HART Version = 6 or 7
	Preambles	5-20	5		
	HART Version	5, 6, 7	5		
A-12	Enable/Disable Diags				
	Enable All	On, Off	Off		
	Disable All	On, Off	On		
	Leakage	On, Off	Off		
	ATC Short	On, Off	Off		
	ATC Open	On, Off	Off		
	Comp Range	On, Off	Off		
	Meas Range	On, Off	Off		
	USP645 Diag	On, Off	Off		
A-13	Auto Hold	On Manual, Off, On Present	On Manual		See end of this table
A-14	Config Timeout				
	Timeout	Always Timeout, Never Timeout, Online Only	Always Timeout		
	Front panel	30 to 999	600		If Timeout = Always Timeout or Online Only
	HART Communication	30 to 999	999		
A-15	Transmitter Tags				
	HART Message	32 characters	(blank)		
	HART Tag	8 characters	(blank)		
	HART Long Tag	32 characters	(blank)		If HART Version = 6 or 7
	HART Descriptor	16 characters	(blank)		
	Tag Name	14 characters	(blank)		
	Location	14 characters	(blank)		
	Device Name	6 characters	(blank)		

Figure	Prompt/Parameter	Parameter Limits	Factory Configuration	User Configuration	Remarks and Notes
A-16	Passcode Access				
	Admin Code	0 to 9999	800		
	User Code	0 to 9999	800		
	User Change				
	Set All On	On, Off	Off		
	Set All Off	On, Off	Off		
	Calibrate	On, Off	On		
	Cal Stability	On, Off	Off		
	Hold	On, Off	On		
	Suspend Fault	On, Off	Off		
	Resume Fault	On, Off	Off		
	Clear History	On, Off	Off		
	Temp Comp	On, Off	On		
	Cell Cfg	On, Off	On		
	PV Cfg	On, Off	On		
	Meas Cfg	On, Off	On		
	Display Cfg	On, Off	On		
	Diag Config	On, Off	Off		
	HART Cfg	On, Off	Off		
	Apps Cfg	On, Off	Off		
	Auto Hold	On, Off	Off		
	Tags Cfg	On, Off	Off		
	Timeouts	On, Off	Off		
	Default Cfg	On, Off	Off		
	Save Cfg	On, Off	Off		
	User view				
	View All	On, Off	Off		
	View None	On, Off	On		
	Cal Stability	On, Off	Off		
	Temp Comp	On, Off	Off		
	Custom Tables	On, Off	Off		
	Display	On, Off	Off		
	Diags	On, Off	Off		
	HART	On, Off	Off		
	Multi Apps	On, Off	Off		
	Auto Hold	On, Off	Off		
	Xmtr Tags	On, Off	Off		
	Timeouts	On, Off	Off		
	Default	On, Off	Off		
A-17	Stability	25.0 to 1000.0 %	100.0 %		
A-18	Restore Config				
	Restore User 1	Yes, No	No		
	Restore user 2	Yes, No	No		
	Restore Factory	Yes, No	No		
If Auto Hold is set to On Manual, the transmitter hold output value limits and factory configuration is as follows:					

Figure	Prompt/Parameter	Parameter Limits	Factory Configuration	User Configuration	Remarks and Notes
14	Manual Hold	- - -	- - -		
	AO Hold	3.6 to 22 mA	3.6 mA		
	PV Hold	(per source)	5 µS/cm		
	SV Hold	(per source)	25°C		
	TV Hold	(per source)	5 µS/cm		
	QV Hold	(per source)	1097.3 Ω		

Appendix C. Auto Calibration

Auto calibration is provided for advanced users with automated systems for cleaning and re-calibrating the probe. These systems require and external control system to orchestrate the process. The transmitter activates its output hold feature, and performs solution calibrations. Auto-service is initiated by the external control system. There is no scheduling nor time delays in the transmitter.

A typical calibration includes:

Activate output hold

Start solution calibration: low, providing known value

Start solution calibration: high, providing known value

Determine when calibration (low or high) is complete

Release output hold

There are two HART hold commands:

Activate Output Hold

Release Output Hold

There are three HART auto-calibration commands:

Start Calibration

Check Calibration Status

Finish Calibration

There are two commands used to save changes

Write Entity Byte Base

Read Entity Byte User Attributes

The following calibrations may be performed:

1,2,3,4,5 point manual measurement calibration

1,2,3,4,5 point smart measurement calibration

1,2 point temperature calibration

2 point mA calibration

Calibration Parameters

Use the following values for:

Calibration Type (1 byte)

    Measurement Calibration 1st point - 102

    Measurement Calibration 2nd point - 103

    Temperature 1st point - 104

    Temperature 2nd Point -105

    mA Calibration 4 mA - 106

    mA Calibration 20 mA - 107

Number of Calibration Points - 1, 2

Calibration Source

    Manual - 2

    Process - 3

Application to calibrate - 1

Calibrator's Initials - 6 characters

Calibration Date - Hart Date format (year, month, day + 1900)

Calibration Units -

    degC   - 4

    degF   - 3

    mA   - 2

    %   - 1

    ppm   - 12

    ppb   - 13

    custom - 15

Command Sequence

1. If explicit output hold is required, issue Activate Output Hold (0x92). Otherwise, automatic hold ensues.

2. Activate automatic system to provide calibration buffer to the sensor.

3. Send Start Cal (0x94) command

4. Send Cal Status (0x95) command, read until measurement is stable

5. Send Finish Cal (0x96) command

6. Repeat steps 2-5 for each calibration point

7. Save changes by writing to save changes and check changes entities.

   a. Write 1 to byte entity 10.

   b. Write 0 to byte entity 11 R

   c. Read entity attributes (8F02000B)

   d. Repeat steps b & c until entity goes invisible.

8. Release any output hold (0x93)

Cmd 148 (0x94): Start Cal

(This command holds off QuickStart)

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : COMMAND

Code Section

     Support In Boot   : False

     Support In Main   : True

     Support Function   : StartCal.

Request: 22 (0x16) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x94	Command 148
1	byte	Fixed	567	0x0D(13d)	Data Length (not including checksum)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	CalPoints
1	byte	Var	567	0x??	CalSource
1	byte	Var	567	0x??	AppIndex
3	date	Var	567	DDMMYY	CalDate
6	char	Var	567	xxxxxx	CalPerson
1	byte	Var	567	0x??	HART Checksum

Response: 24 (0x18) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x94	Command 148
1	byte	Fixed	567	0x0F(15d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	CalPoints
1	byte	Var	567	0x??	CalSource
1	byte	Var	567	0x??	AppIndex
3	date	Var	567	DDMMYY	CalDate
6	char	Var	567	xxxxxx	CalPerson
1	byte	Var	567	0x??	HART Checksum

Cmd 149 (0x95): Read Cal Status

(This command holds off QuickStart)

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : COMMAND

Code Section

    Support In Boot   : False

    Support In Main   : True

    Support Function   : RdCalStatus.

Request: 10 (0x0A) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x95	Command 149
1	byte	Fixed	567	0x01(1d)	Data Length (not including checksum)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	HART Checksum

Response: 18 (0x12) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x95	Command 149
1	byte	Fixed	567	0x09(9d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	CalStable
1	byte	Var	567	0x??	CalUnits
4	real	Var	567	? 0.0	CalValue
1	byte	Var	567	0x??	HART Checksum

Cmd 150 (0x96): Finish Cal

(This command holds off QuickStart)

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : COMMAND

Code Section

    Support In Boot   : False

    Support In Main   : True

    Support Function   : FinishCal.

Request: 15 (0x0F) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x96	Command 150
1	byte	Fixed	567	0x06(6d)	Data Length (not including checksum)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	CalUnits
4	real	Var	567	? 0.0	CalValue
1	byte	Var	567	0x??	HART Checksum

Response: 17 (0x11) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x96	Command 150
1	byte	Fixed	567	0x08(8d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
1	byte	Var	567	0x??	CalType
1	byte	Var	567	0x??	CalUnits
4	real	Var	567	? 0.0	CalValue
1	byte	Var	567	0x??	HART Checksum

Cmd 142 (0x8E): Write Entity Byte Base

(This command holds off QuickStart)

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : WRITE

Code Section

 Support In Boot   : False

 Support In Main   : True

 Support Function   : HARTE_BytWrBase.

Request: 12 (0x0C) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x8E	Command 142
1	byte	Fixed	567	0x03(3d)	Data Length (not including checksum)
2	int	Var	567	0	EntityIndex
1	byte	Var	567	0x00	EntityValue
1	byte	Var	567	0x??	HART Checksum

Response: 15 (0x0F) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x8E	Command 142
1	byte	Fixed	567	0x06(6d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
2	int	Var	567	? 0	EntityIndex
1	byte	Var	567	0x??	EntityValue
1	byte	Var	567	0x??	Error
1	byte	Var	567	0x??	HART Checksum

Cmd 143 (0x8F): Read Entity Byte User Attributes

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : READ

Code Section

    Support In Boot   : False

    Support In Main   : True

    Support Function   : HARTE_BytRdUserAtt.

Request: 11 (0x0B) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x8F	Command 143
1	byte	Fixed	567	0x02(2d)	Data Length (not including checksum)
2	int	Var	567	1	EntityIndex
1	byte	Var	567	0x??	HART Checksum

Response: 20 (0x14) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x8F	Command 143
1	byte	Fixed	567	0x0B(11d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
2	int	Var	567	? 0	EntityIndex
1	byte	Var	567	0x??	InVisibility = 0x80 bit
4	byte	Var	567	0x????????	PicksInVisible
1	byte	Var	567	0x??	Error
1	byte	Var	567	0x??	EntityValue
1	byte	Var	567	0x??	HART Checksum

Cmd 146 (0x92): Activate Output Hold

(This command holds off QuickStart)

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : COMMAND

Code Section

      Support In Boot   : False

      Support In Main   : True

      Support Function   : ActivateOutputHold.

Request: 30 (0x1E) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x92	Command 146
1	byte	Fixed	567	0x15(21d)	Data Length (not including checksum)
1	byte	Var	567	0x??	Hold Mode
4	real	Var	567	3.6	Hold mA
4	real	Var	567	7	Hold PV (a)
4	real	Var	567	25	Hold SV (a)
4	real	Var	567	0	Hold TV (a)
4	real	Var	567	109.73	Hold QV (a)
1	byte	Var	567	0x??	HART Checksum

a. PV, SV, TV, and QV must be presented in the base units used in the transmitter: Degrees Celsius, Ohms for RTD, kOhms for electrodes, mS/cm.

Response: 32 (0x20) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x92	Command 146
1	byte	Fixed	567	0x17(23d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
1	byte	Var	567	0x??	Hold Mode
4	real	Var	567	3.6	Hold mA
4	real	Var	567	7	Hold PV (a)
4	real	Var	567	25	Hold SV (a)
4	real	Var	567	0	Hold TV (a)
4	real	Var	567	109.73	Hold QV (a)
1	byte	Var	567	0x??	HART Checksum

a. PV, SV, TV, and QV must be presented in the base units used in the transmitter: Degrees Celsius, Ohms for RTD, kOhms for electrodes, mS/cm.

Possible HART Command Status errors returned:

(5) 0x05 Error   Too few data bytes received

Cmd 147 (0x93): Release Output Hold

HART Command Type   : Device Specific

HART Versions   : 5 6 7

HART Operation Type   : COMMAND

Code Section

     Support In Boot   : False

     Support In Main   : True

     Support Function   : ReleaseOutputHold.

Request: 9 (0x09) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x82	Request Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x93	Command 147
1	byte	Fixed	567	0x00(0d)	Data Length (not including checksum)
1	byte	Var	567	0x??	HART Checksum

Response: 11 (0x0B) bytes (plus preambles)

Size	Type	Fixed/Var	HART Ver #	Example	Description
1	byte	Fixed	567	0x86	Response Delimiter
5	byte	Var	567	0x??????????	Device Address
1	byte	Fixed	567	0x93	Command 147
1	byte	Fixed	567	0x02(2d)	Data Length (not including checksum)
1	byte	Var	567	0x00	HART Command Status
1	byte	Var	567	0x??	HART Device Status (Configuration Changed Flag set)
1	byte	Var	567	0x??	HART Checksum

ISSUE DATES

FEB 2011
NOV 2011
FEB 2015
JUN 2016

Vertical lines to the right of text or illustrations indicate areas changed at last issue date.

Invensys Systems, Inc.
38 Neponset Avenue
Foxboro, MA 02035
United States of America
http://www.schneider-electric.com

Global Customer Support
Inside U.S.:   1-866-746-6477
Outside U.S.: 1-508-549-2424
Website: http://support.ips.invensys.com

0616

Foxboro®
by Schneider Electric